

# Motorship

Registered in U. S. Patent Office and abroad



Capacity, 5000 tons of solids per hour  
—and self-reliant as a dredge can be

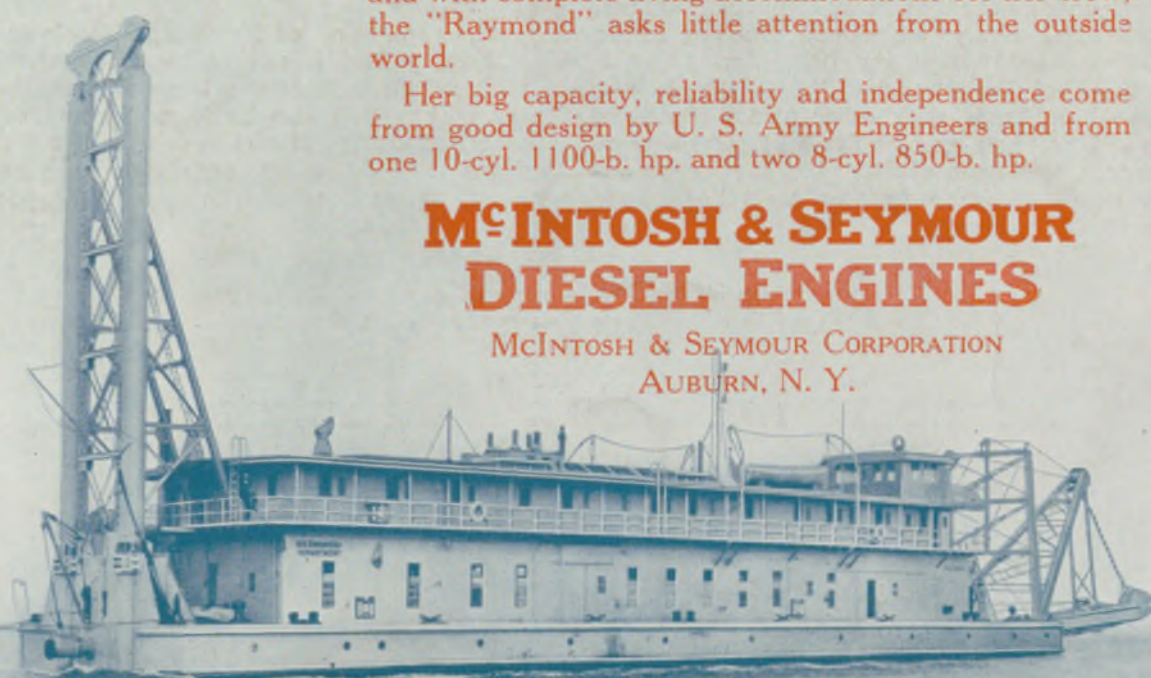
**T**HE 20-in. Hydraulic Dredge "Raymond" of the War Department applies 1100 b. hp. to her dredging pump and provides an additional 1150 hp. for a motor-driven booster at the shore end of her delivery line.

With ample Diesel power for 16 hr. per day heavy work day in day out, with an exceptionally long run on each fueling, with overhauling facilities on board, and with complete living accommodations for her crew, the "Raymond" asks little attention from the outside world.

Her big capacity, reliability and independence come from good design by U. S. Army Engineers and from one 10-cyl. 1100-b. hp. and two 8-cyl. 850-b. hp.

## McINTOSH & SEYMOUR DIESEL ENGINES

McINTOSH & SEYMOUR CORPORATION  
AUBURN, N. Y.



SEPT., 1927

PRICE 35c.



# Motorship

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Number 9

## The Motorship As a Refiner of Trade Routes and a Saver of Time and Money

Examination of Speed Performance of Existing Motor Freighters Shows That Noteworthy Records Are Being Created, Record Cargoes Transported, While Many Shipowners Abandon the Steamer Altogether

SAILING of the new Kerr motorliners SILVERGUAVA on July 20 and SILVERBELLE on August 11 serves as another reminder of the very competitive nature of round the world services from New York and indeed of the competition which the motorship is now inducing on all long haul trade routes. MS. SILVERGUAVA is the third of six motorships of 9,000 tons dw. which the Silver Line, Ltd., of London, is building for the Kerr Lines round-the-world trade. Two sister ships, the SILVERASH and SILVERBEECH, are already in service, and a fourth, the SILVERHAZEL, which was launched the latter part of April, is already in service. The SILVERGUAVA was scheduled to sail from New York July 20; and the SILVERBELLE sailed on August 11 with a full cargo. The SILVERMAPLE was launched on August 15 of this year.

When all six vessels are in service they will establish a schedule of sailings from New York every 3 weeks. They will replace the company's 11 knot ships, which are considered too slow for the world service. The 11 knot ships are, however, doing excellent work in transporting freight to and from San Francisco and Los Angeles to the Dutch East Indies and India. Some record cargoes have been carried by the 11 knotters on their new service and record speeds have been made. For example 6,000 bales of raw rubber, said to have been the largest single shipment of

that commodity ever brought into San Francisco arrived recently on the Kerr Line motorship SILVERLARCH. This vessel operates in the Pacific-Calcutta-Java service of

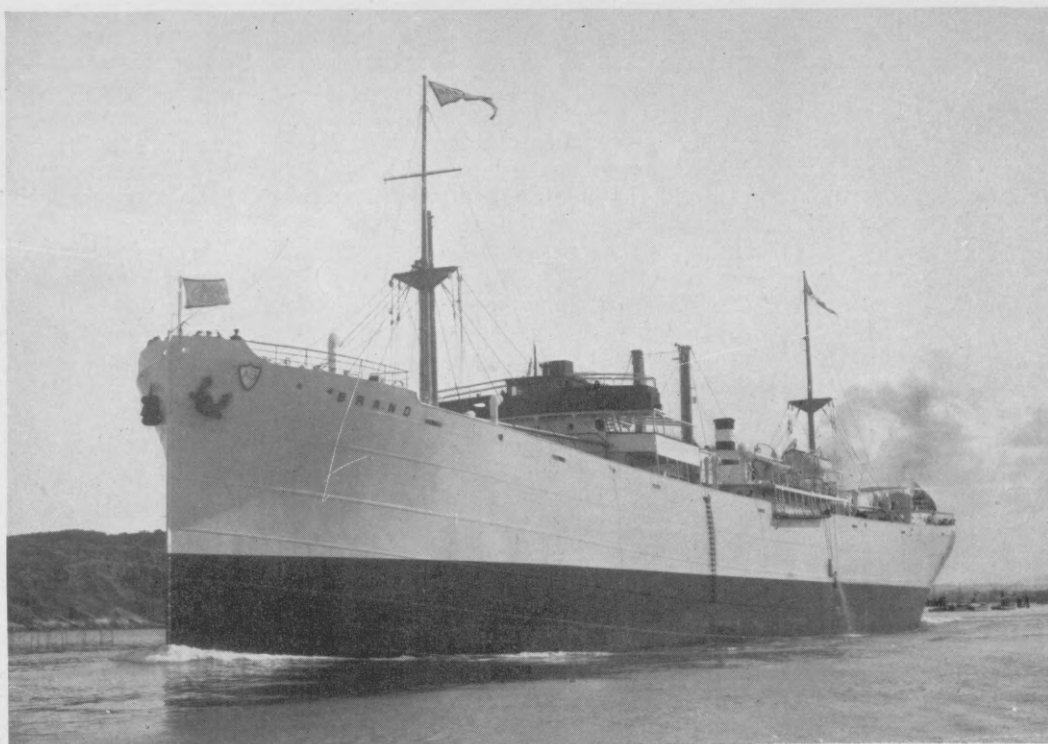
rated the only direct service from the Pacific Coast to Calcutta, proceeding to that port from Batavia via Singapore, Belawan and Penang. The service is now maintained by monthly sailings of motorships from Los Angeles and San Francisco.

The new motorship SILVERBELLE, sistership to the SILVERGUAVA, underwent a satisfactory trial trip on July 1 off Sunderland as has been mentioned easily attained a speed of 15.70 knots which is a very creditable speed for a motor freighter. Presumably the trials were carried out in the light condition, but even so this should ensure for the ship a sea (loaded) speed of about 14 knots.

MS. SILVERBELLE sailed on her maiden voyage from New York on August 11 in the express service to Yokohama, Kobe, Shanghai and Man-

ila via Hampton Roads and Savannah. Outward bound she used the Panama Canal and on the homeward voyage the Suez Canal. She is the fourth of six sister motorships specially built for this service, and generally sailing well loaded with various kinds of American merchandise, and in which the following schedule is made: Yokohama, 36 days; Kobe, 37 days; Shanghai, 42 days, and Manila, 48 days.

This schedule is interesting to compare with a new fast steamer schedule announced recently by Funch, Edye & Co., Inc., outward freight agents for the Blue Funnel Line, comprising the fleets of the



Modern freight carrying motorships of this type are now taking the steamers' cargoes. Our laws, high cost of construction, and lack of government aid has caused many fine American-owned motorships to be built abroad

the line represented on the West Coast by the General Steamship Corporation. She also had a heavy shipment of copra and gum dammar.

Late in June, word was received by the General Steamship Corporation that the Kerr Line motorship SILVERAY reached Batavia, principal port of Java, 36 days after her departure from San Francisco, or 6 days in advance of the schedule, demonstrating exceptional speed on this outbound voyage. Prior to her arrival at Batavia she called at Macassar, Soerabaya and Samarang, having reached the first East Indies port in only 29 days. This vessel inaugu-

China Mutual Steam Navigation Company, Ltd., and the Ocean Steamship Company, Ltd.

This table of dates shows a regular service of vessels from this port to Penang in 34 days, Singapore in 37 days, Manila in 44 days and Hongkong in 50 days, on what is known as the "southern run," via the Suez Canal. On the "northern run," via the Panama Canal, Yokohama is scheduled to be made in 37 days, Kobe in 40 days and Shanghai in 46 days.

In conjunction with the Booth American Shipping Corporation, inward and general agents for the Blue Funnel Line, Funch, Edye & Co. have also announced an inward schedule from Shanghai to New York

Yokohama, Kobe, Shanghai, and Hong Kong, which are in effect Key ports to Far Eastern trade.

These steamers represent very definite rivalry for the motorships because—they are Blue Funnel liners, which shipping fleet numbers among its units the fastest and finest freighters in the world. They are however steamers and old steamers. Their schedule is longer than that of existing motorships and, although rivals, they will constitute on world trade routes a very definite incentive to motorshippers to give the best of service—to give a better service, a cleaner service, and a quicker service. This they should have no difficulty in doing.

### Blue Funnel Steamers & "Silver" Motorliners Schedules

VIA SUEZ (STEAMERS)	VIA PANAMA (STEAMERS)	VIA PANAMA (MOTORSHIPS)
Penang ..... 34 days	Yokohama ..... 37 days	Yokohama ..... 35 days
Singapore ..... 37 days	Kobe ..... 40 days	Kobe ..... 37 days
Manila ..... 44 days	Shanghai ..... 46 days	Shanghai ..... 42 days
Hong Kong ..... 50 days		Hong Kong ..... 47 days

of 62 days, from Hongkong of 58 days, from the Philippines of 50 days, from Singapore of 41 days, and from Penang of 39 days. Boston is made a port of discharge and vessels are scheduled to arrive there two days prior to New York.

In starting this new service the following vessels were placed on berth: TEUCER, 9,064 gross tons, sailing July 13; EUMAEUS, 7,735 tons, August 10; ELPENOR, 7,601 tons, September 7; TITAN, 9,029 tons, September 14; AGAPENOR, 7,586 tons, October 5; HELENUS, 7,554 tons, November 2; PELEUS, 7,441 tons, October 26; MENTOR, 7,610 tons, November 30, and NELEUS, 6,684 tons, December 28.

The TEUCER, TITAN and PELEUS are routed via the Panama Canal, the others via the Suez Canal.

These sailings can, for reference, be conveniently reduced to tabular form and it is interesting to make comparison with the schedule of the fast Silver Line boats. The fast Furness freighters make much the same time as the "Silver" line boats to

Motorships nowadays are continually making, and breaking, records. For example, MS. ALYNBANK, Bank Line 11-12 knot freighter, made an exceptionally rapid passage with a cargo of lumber between Astoria and Sydney, arriving in the latter port on June 27 after a 25-day trip. The converted Shipping Board motorships, too, have more than justified the expectations of their engine builders. To quote one instance only, the motorship WEST HONAKER, first Diesel vessel in the Roosevelt Steamship Co.'s round-the-world service via Australia and India, recently made a run from Fremantle to Colombo in 13 days. She later passed through Suez Canal bound for New York.

The Shipping Board vessels are all single screw ships with long stroke crosshead engines. A trunk piston twin screw installation is fitted in the freighter BRANDANGER of the Westfal-Larsen Line which reached Bahia Blanca, Argentina, from San Francisco in exactly 30 days. This vessel holds all records for speed in the Pacific Coast-

Argentine-Brazil trade, having made the voyage from Santos to Los Angeles in 26 days. The motorship HOYANGER, sister of the BRANDANGER, recently entered this trade, and reached Los Angeles on July 15 with a record cargo of coffee from Brazil and miscellaneous products from Argentina.

What is declared to be a record for any motor tanker was established recently with the arrival at San Francisco of the Standard Transportation Company's light oil carrier LIO. The vessel completed two trips around the world with her Bethlehem Diesel. More than 46,502 nautical miles were navigated, during this voyage.

On the voyage, at different times, the ship transported more than 250,000 barrels of kerosene and gasoline. The LIO cleared San Francisco on a later trip with 83,000 barrels of gasoline for Providence, R. I. Her machinery functions splendidly.

As a matter of fact, the motorship is now definitely established not only in the Pacific, but also in the South American trade, where it is steadily replacing steamers. As an example of this fact we may recall that the Latin-America Steamship Company is Dieselizing its entire fleet operating between Pacific Coast ports and South America and is increasing the number from four to six carriers.

The steamers REMUS, REGULUS and ROMULUS were scheduled to be supplanted on the run by new motorships beginning in August, while two new motorships will be added late this year. The motorship CHILDIR, already in the service, is remaining in the service.

All vessels, in addition to freight, will have accommodations for a number of passengers.

As an example of the reliable and economical service given by motorships, we may cite finally an important recent case of two Norwegian motorships chartered by a Pacific Coast lumber exporter for periods of 5 years each at a rate of \$1.50. This is said to be the longest period for which cargo vessels have ever been taken for Pacific Coast trade, although tankers have been engaged for as long as ten years.

## And Now the 20-Knot Coastwise Motorships

MANY of the stock objections to installing Diesel engines in fast coastwise motorships so often advanced by steam interests in this country are rapidly disappearing under the fierce light of successful performance of such ships in foreign countries. The PREUSSEN and her sister HANSESTADT DANZIG, two fast vessels designed to operate on day or night runs between the two Baltic Packet ports of Swinemunde and Pillau, some 255 miles. These vessels are 262.5 ft. in length b.p., by 38.1 ft. beam, and 22.5 ft. depth. They have accommodation for 1,403 passengers and are powered by two 10-cylinder single-acting, 4-cycle M.A.M. Diesels operating normally at about 260 r.p.m. They can make about 15 knots on 3,500 b.h.p., but owing to supercharging each engine's output can be boosted to 2,500 b.h.p., in which case the vessel can maintain round about 17 knots with 5,000 b.h.p. total.

The HANSESTADT DANZIG has been in service now practically a year but when she was completed it was not possible to

run trials of the ship. Consequently, a special series of trials was run in July, during which under full power a mean speed of 20.2 knots during a 6-hr. run was obtained. This constitutes something like a record for a motorship of this vessel's size and power.

Dimensions of the two ships are moderate. Draft and displacement are not very great. Passenger accommodation is large. Twin-screw, high speed Diesels, of the trunk-piston type, originally developed for German submarine cruisers, although each is a 10-cylinder machine, do not take up excessive space and with the small auxiliary engine room forward of the main engine room the total machinery space is less than that which would be required for engines and boilers with a corresponding turbine installation. Particularly is this so as the opportunity has been taken in these ships to deck over above the third deck the auxiliary engine room. This would in part correspond to the boiler room in a steam installation and, of course, a normal amount

of deck space above would be taken up by uptakes.

With the HANSESTADT DANZIG and her sister it would seem that we are measurably within distance of solving the purely physical problems of applying the Diesel to fast coastwise ships. There remains however, our pro-steam friends will tell us, the question of cost, but this in America is not as high as would appear in the first instance, particularly if standard engines of some well-known make be used, and if the saving due to economy of operation be added. The idea with the fast coastwise motorship is to take some standard engine which can be produced at reasonable cost and adapted to the needs of the fast ship and not to design some entirely new engine of prohibitive cost. Diesel engine manufacturers have got to get around seriously to think of this problem, and coastwise shipowners have got to get out of the clutches of the hard and fast steam enthusiasts whose enthusiasm is often biased with the bias of ignorance.



# Shipping Board Opens Diesel Engine Bids

Six Manufacturers Quote on Eight Single-Acting and Double-Acting Direct-Drive Engines of 3500 to 4000 B.H.P. Each

**B**IDS on direct-drive Diesel engines for the second conversion program of the U. S. Shipping Board were opened in New York on August 15th by Captain R. D. Gatewood, Manager of Maintenance and Repair Division, of the Merchant Fleet Corporation.

Bids were invited on two, three, four or six main engines of the single-acting or double-acting, two-cycle or four-cycle types of 3500 to 4000 b.h.p. each at 95 to 115 r.p.m. The Board, however, permitted the engine manufacturers to submit engines of higher speeds where the design permits such speed at continuous operation. The operating speeds will be determined by characteristics of vessels to be converted.

Under "maximum normal" rating the piston speed is not to exceed a thousand feet per minute while the mean-indicated pressure for four-cycle engines is not to be over 90 pounds per square inch, or 85 lbs. per square inch for two-cycle engines.

Only six manufacturers were invited to bid, namely, Busch-Sulzer Brothers Diesel

Engine Co., Hooven, Owens, Rentschler Co., McIntosh & Seymour Corporation, New London Ship & Engine Co., Sun Shipbuilding and Drydock Co. and the Worthington Pump and Machinery Co. All six firms submitted bids, as below.

Busch-Sulzer bid on two-cycle, single-acting engines; Sun Shipbuilding & Drydock Co. bid on opposed-piston oil engines with a shorter stroke for the upper piston than for the lower piston, while Worthington Pump Co.; Hooven, Owens, Rentschler; and the New London Ship & Engine Co. bid on two-cycle, double-acting engines. McIntosh & Seymour bid on five-cylinder, four-cycle, double-acting Diesel engines, 32-in. bore, 52-in. stroke, developing 3900 b.h.p. at 110 r.p.m., or 4650 b.h.p. at 116 r.p.m. with delivery of the first engine in eight months.

Air injection of fuel is stipulated by the Shipping Board for all engines, the injection-air compressor to be driven off the forward end of the engine crankshaft. All engines must come within the length of the

engine room, which is 52 ft. 6 in. between bulkheads.

In the case of two-cycle engines alternative proposals were estimated for direct-driven scavenging pumps and independent scavenging blowers supplied in duplicate. All main bearings and the connecting-rod bearing boxes are to be equipped with laminated multi-leaf shims and the maximum pressure per square inch of projected area for the crank-pin and crosshead bearing is 1400 pounds.

The number of engines ordered will be decided after careful study of the bids and the total cost of the engines, together with the estimated cost of the conversion work.

The Worthington company also submitted a bid on 10 engines, which was not called for in the specifications.

Bids on Diesel engines for the two Diesel electric ships to be converted under the direction of Gibbs Brothers and Rear Admiral D. A. Taylor, have not yet been opened. It is expected that the specifications will be issued shortly.

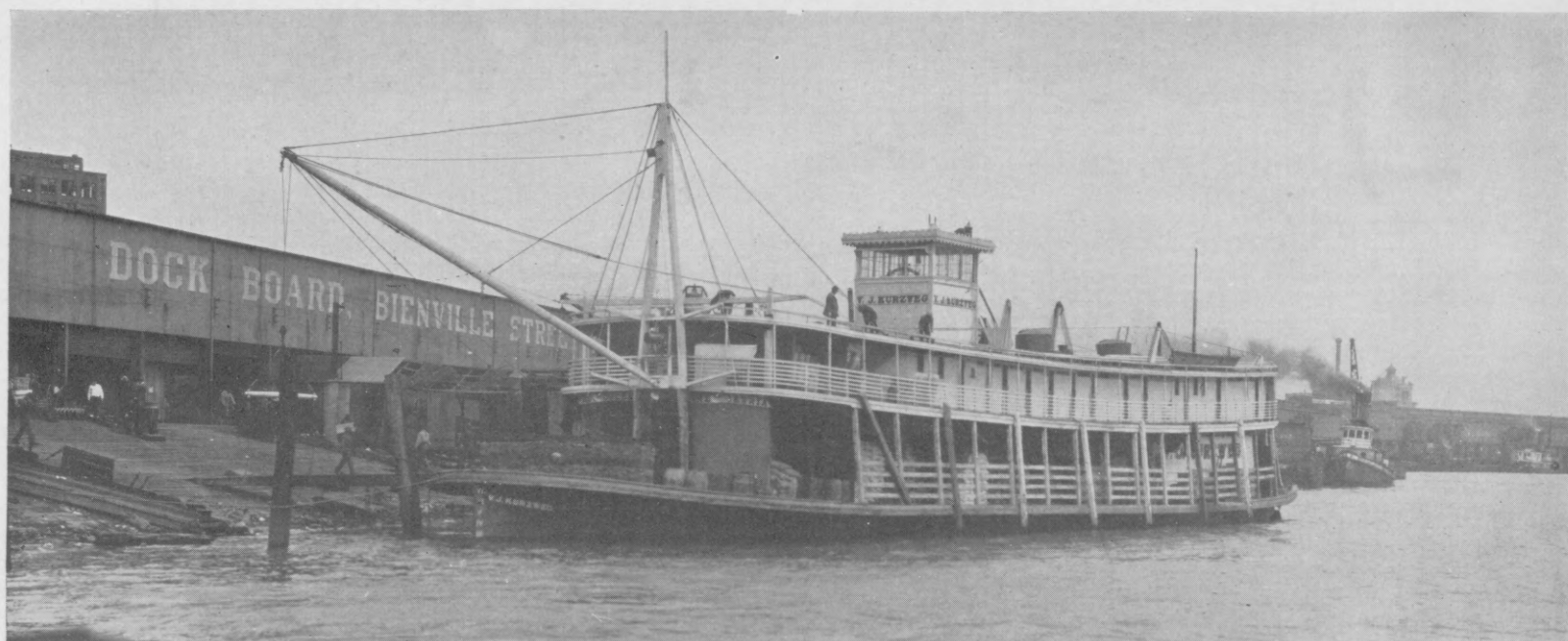
Builder's Name	Busch-Sulzer Bros., St. Louis, Mo.		Hooven-Owens-Rentschler Company, Hamilton, Ohio		McIntosh-Seymour Corp'n, Auburn, N. Y.		Sun Shipbuilding & D. Co., Chester, Pa.		
Type of engine	2-Cycle S. A.	2-Cycle S. A.	2-Cycle D. A.	2-Cycle D. A.	2-Cycle D. A.	4-Cycle D. A.	4-Cycle D. A.	Opposed Piston	2-Cycle S. A.
Brake Horse Power	3,800	3,950	†3,900	†4,220	†4,220	3,900	3,900	3,500	3,650
Diam. of working cylinders—in	30	30	27.50	27.50	27.50	32	32	25.19	25.19
Stroke of working cylinders—in	52	52	47.25	47.25	47.25	52	52	Comb. 97.63	Comb. 97.63
Number of working cylinders	6	6	4	4	4	5	5	4	4
R.p.m.	100	104	115	115	115	110	110	95	95
Fuel per b.h.p.-hr., lbs.	0.39	0.39	0.445	0.435	0.435	0.42	0.42	0.41	0.394
Displacement wkg.-cyl's, cu. ft.	128.64	128.64	129.93	129.93	129.93	247.01	247.01	112.62	112.62
Total weight, lbs.	819,000	825,000	859,000	777,000	774,940	925,000	925,000	908,000	834,000
Weight per b.h.p., lbs.	215.53	208.86	214.8	179.81	179.38	237.18	237.18	259.43	228.49
Weight per cu. ft. disp., lbs.	6,366.6	6,413.25	6,611.25	5,980.14	5,964.29	3,822.16	3,822.16	8,062.51	7,405.43
Type of scav. pump	Ind. G.E. blower	Ind. Elliott blower	Direct connected	Ind. A. B. B. Corp. S. M.	Ind. A. B. B. Corp. D. M.	No scav. pump	No scav. pump	Direct Connected	Ind. A. B. B. Corp'n D. M.
Total length of eng.—ft., in.	43' 3½"	43' 3½"	37' 9"	28' 8½"	28' 8½"	37' 11"	37' 11"	44' 3"	41' approx.
Height of eng. from C. L. of C.—shaft	25' 3½"	25' 3½"	26' 2"	26' 2"	26' 2"	30' 5"	31' 1"	29' 9"	29' 9"
Duration test 1st engine	7 days	7 days	30 days	30 days	30 days	10 days	10 days	.....	.....
Total price one eng. with test and spares	\$619,516	\$626,666	\$629,515.26	\$612,852.26	\$608,062.18	\$576,000	\$580,000	\$857,800	\$873,950
Total price two engs. with test and spares	\$893,424	\$902,224	\$924,772.89	\$900,778.38	\$892,563.27	\$849,000	\$853,500	(No Test)	(No Test)
Total price three engs. with test and spares	\$1,160,032	\$1,167,732	\$1,219,030.52	\$1,185,704.52	\$1,176,084.36	\$1,112,000	\$1,118,000	.....	.....
Total price four engs. with test and spares	\$1,709,248	\$1,714,748	.....	.....	.....	\$1,646,500	\$1,655,500	.....	.....
Total price six engs. with test and spares	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total price ten engs. with test and spares	.....	.....	.....	.....	.....	.....	.....	.....	.....
Delivery 1st engine	11 months	11 months	12 months	12 months	12 months	8 months	8 months	.....	.....
Delivery 2nd engine	12.5 months	12.5 months	15 months	15 months	15 months	10 months	10 months	11 months	11 months
Delivery 3rd engine	14 months	14 months	18 months	18 months	18 months	12 months	12 months	13 months	13 months
Delivery 4th engine	15.5 months	15.5 months	21 months	21 months	21 months	14 months	14 months	.....	.....
Delivery 5th engine	17 months	17 months	.....	.....	.....	16 months	16 months	.....	.....
Delivery 6th engine	18.5 months	18.5 months	.....	.....	.....	18 months	18 months	.....	.....
Delivery 10th engine	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total weight (eng. scav. pump and all spares)	\$855,000	\$861,000	\$904,000	\$822,000	\$819,940	\$1,017,472	\$1,017,472	\$939,000	\$865,000
Price per lb. (everything) on 2-eng. basis	\$0.362	\$0.364	\$0.348	\$0.373	\$0.371	\$0.283	\$0.285	\$0.457	\$0.505

Builder's Name	New London Ship & Engine Co., Groton, Conn.		Worthington Pump & Machinery Corporation, New York, N. Y.		
Type of engine	2-Cycle D. A.	2-Cycle D. A.	2-Cycle D. A.	2-Cycle D. A.	2-Cycle D. A.
Brake Horse Power	3,700	4,000	4,000	3,360	3,625
Diam. of working cylinders—in	27.55	27.55	27.55	28	28
Stroke of working cylinders—in	47.25	47.25	47.25	40	40
Number of working cylinders	4	4	4	4	4
R.p.m.	115	115	115	115	115
Fuel per b.h.p.-hr., lbs.	0.441	0.407	0.407	0.43	0.425
Displacement wkg.-cyl's, cu. ft.	129.93	129.93	129.93	114.03	114.03
Total weight, lbs.	857,500	739,500	739,500	770,000	769,060
Weight per b.h.p., lbs.	231.8	184.8	184.8	229.17	212.15
Weight per cu. ft. disp., lbs.	6,599.7	5,691.5	5,691.5	6,752.61	6,744.37
Type of scav. pump	Direct connected	Ind. De Laval S. M.	Ind. G. E. Co. S. M.	Direct connected	Ind. A. B. B. Corp'n S. M.
Total length of eng.—ft., in.	37' 11"	28' 8½"	28' 8½"	41' 5"	34' 5"
Height of eng. from C. L. of C.—shaft	27' 10"	27' 10"	27' 10"	26' 5½"	26' 5½"
Duration test 1st engine	2 days	2 days	2 days	7 days	7 days
Total price one eng. with test and spares	\$437,714	\$477,449	\$422,901	\$530,868.82	\$543,203.50
Total price two engs. with test and spares	\$860,428	\$844,881	\$831,785	\$769,849.23	\$789,371.25
Total price three engs. with test and spares	.....	\$1,252,310	\$1,238,666	\$1,000,689.64	\$1,034,655.00
Total price four engs. with test and spares	.....	.....	.....	\$1,463,576.46	\$1,519,564.50
Total price six engs. with test and spares	.....	.....	.....	\$2,278,154.10	\$2,405,937.50
Total price ten engs. with test and spares	.....	.....	.....	.....	.....
Delivery 1st engine	15 months	15 months	15 months	12 months	12 months
Delivery 2nd engine	18 months	18 months	18 months	13 months	13 months
Delivery 3rd engine	22 months	22 months	22 months	15 months	15 months
Delivery 4th engine	.....	.....	.....	16 months	16 months
Delivery 5th engine	.....	.....	.....	17 months	17 months
Delivery 6th engine	.....	.....	.....	18 months	18 months
Delivery 10th engine	.....	.....	.....	24 months	24 months
Total weight (eng. scav. pump and all spares)	\$893,613	\$778,209	\$778,209	\$805,200	\$804,200
Price per lb. (everything) on 2-eng. basis	\$0.481	\$0.543	\$0.534	\$0.330	\$0.338

\*Bids not directly comparable due to omission of full detailed prices of spares for independent driven blowers.  
†Based on 85 lbs. M.I.P. ‡Area of piston has been disregarded in all cases.





## Diesel Transportation Cheap on Rivers

Packet Boat with 240 Hp. Diesel Handles Cargo at Cost of 13.8 Cents per Ton Compared with 51.4 Cents per Ton with Steam

THE operating record of the V. J. KURZWEG, a packet boat equipped with a 240-hp. F-M Diesel in service between New Orleans and New Iberia, demonstrates very clearly the savings which are possible when the Diesel engine is applied to Western River Packets. In this instance it has been possible to make a definite comparison with a steam-equipped vessel which operates over the same 516 miles round trip as the KURZWEG.

This vessel, the CLIPPER, consumed 80 bbl. of fuel oil at \$1.85 per bbl. at a total cost of \$148 per trip. To this cost of fuel the labor cost of two firemen at \$30 per trip and the cost of lubricating oil and grease at \$2 per trip must be added which makes a total of \$180 per trip. The average cargo for the CLIPPER is 350 tons and figuring the cost on a tonnage basis the

power cost, taking into consideration three items mentioned, is 51.4 cents.

According to O. L. Dulion, Manager of the Marine Department of the New Orleans Branch of Fairbanks, Morse Co., the V. J. KURZWEG on the same run is consuming 650 gal. of fuel oil at 6½ cents per gal. and also 12 gal. of lubricating oil at 50 cents per gal., making the total fuel and lubricating cost \$48.25. In other words the net saving is \$131.75 per trip since the labor cost of the firemen is eliminated on the Diesel-equipped KURZWEG. Since this vessel is handling the same cargo as the CLIPPER and handling it at a cost of 13.8 cents per ton, the saving over a period of one year would amount to approximately \$7,000.

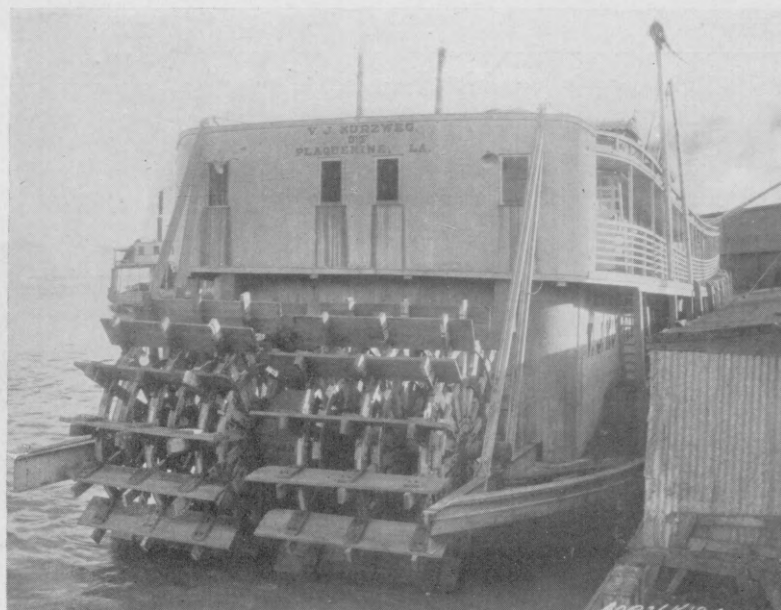
This packet was built by the Canulet Shipbuilding Company of Slidell, La., for the Consolidated Companies of Plaquemine,

La. The vessel is operated by the Shellburn Transportation Company, a subsidiary of the Consolidated Companies, and she was designed by Captain T. C. Booksh.

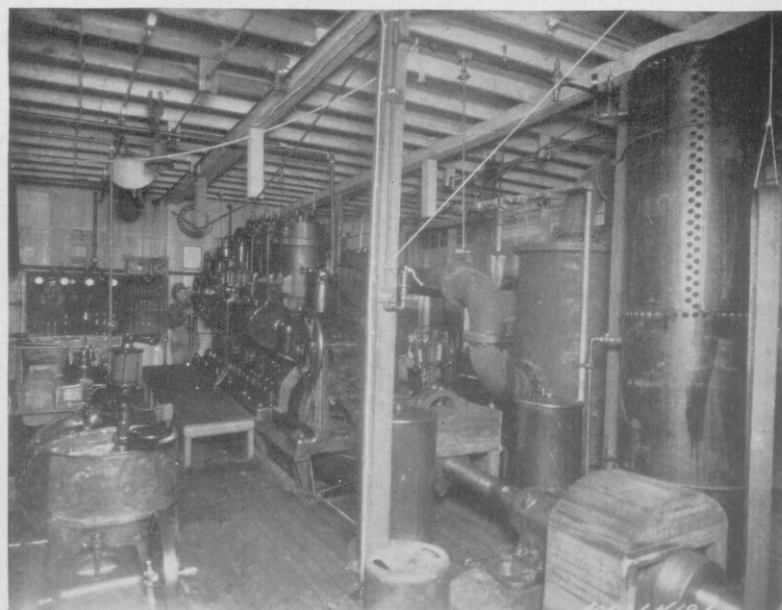
The KURZWEG has an overall length of 155 ft., with a beam of 32 ft., and the draft light aft is 3 ft. 3 in., and the draft forward light is 18 in. The gross tonnage is 250 and the net tonnage is 230.

The 240-hp. F-M Diesel is clutch connected to the main shaft. The stern wheel carries the F-M reduction gear in the center of the wheel shaft making it necessary to split the buckets at the center point where the gear housing arm rests on the false transom.

The design is adapted to take care of the flexibility generally existing between the hull of the vessel and the stern-wheel. Shocks transmitted to the drive in starting and reversing are taken care of by an



Split sternwheel turns normally at 23 r.p.m.



Engine room of V. J. Kurzweg showing 240 hp. Diesel



amply-proportioned shaft made of heat-treated steel. Undue torsional and bending strains are also prevented by the large size of the shaft, which easily supports the transmission case and wheels.

The buckets are split in two sections 9 ft. 3 in. long and each set of buckets are staggered in order to reduce vibration when operating at slow speeds in shallow water. Each section is 15 ft. 6 in. in diameter and there are 15 buckets on each section. At rated engine speed the stern wheel turns at 23 r.p.m. which in pool water gives a speed of  $8\frac{1}{2}$  miles per hour.

Since this boat is the largest that has ever entered the Bayou Teche trade and since the water is very shallow in many parts of this run, it will be necessary to

cut down the speed of the wheel to 8 or 10 r.p.m.

This packet is a typical steam boat in appearance except that she has no smoke stacks. The boat is fitted out in real steam-boat style even to the fore-castle signboards patterned after the handsome curved signboards on the fore-castle of the steamer QUEEN CITY. The KURZWEG has a full cabin with skylights and large staterooms. She also has an S. J. Gardner pneumatic steering gear operated by compressed air, an electric hoist for the stage, and is equipped with electric freight conveyors on the main deck.

On a high stage of water the vessel makes  $5\frac{3}{4}$  miles per hour up stream and 10 miles down on that part of the run on

the Mississippi river between New Orleans and Plaquemine. Leaving New Orleans, Tuesday evening, the KURZWEG has returned from New Iberia as early as ten o'clock Saturday night.

The KURZWEG is just another example of how the Diesel is giving an entirely new conception to what constitutes economical river boat operation. In addition to the saving in fuel cost the simplicity of the Diesel in general and of this Diesel in particular is an important advantage in river service. It not only reduces the actual cost of operation but makes it possible to change over from steam operation without increasing the problem of securing competent engineroom help. In fact, the Diesel secures real all around superiority.

## Performance of an Alaskan Motorship

THE freight and passenger boat "A. B. CARPENTER" is 105 ft. long with a beam of 23 ft. 8 in., and a draft of 7 ft. 3 in. and is equipped with a 180 hp. C.O. Diesel. She has a 3-blade propeller 62 in. diameter and 34 in. pitch and makes 12.6 m. p. h. The engine is a Fairbanks Morse. The ship made three round trips from Seattle to Nome, Alaska, recently, calling at way ports en route. Since starting voyage No. 1 on May 12th the engine operated

would have cost much more than the amount of oil lost through leaks.

The ship is a sturdily built vessel with ample deck space for cargo forward of the main superstructure which contains accommodations.

The average fuel consumption at cruising speed was 10 1-3 gal. per hr. but on necessary occasions the fuel consumption was increased to  $11\frac{1}{2}$  gal. per hour. By actual experience it was found the engine

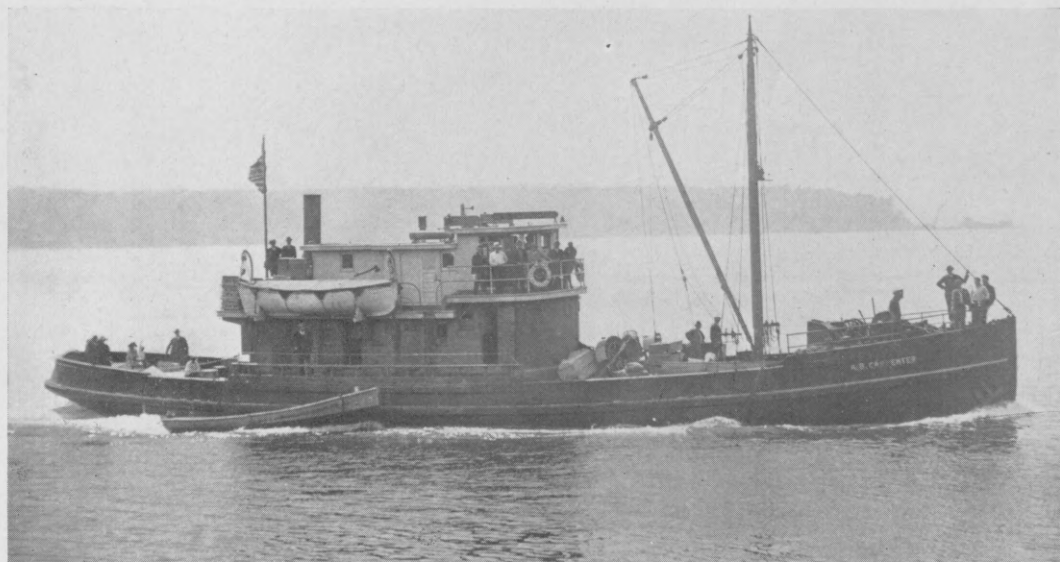
in Northern waters and it was comforting to know we had an engine that would perform in a dependable manner.

### Diesel Boarding Tugs

United States Public Health Service Boarding Launch, EUGENE WASDIN, is one of two 50 ft. Boarding Tugs recently built by the Vineyard Ship Building Company of Milford, Del., for the United States Public Health Service in Washington. They are of exceptionally strong construction as they were designed to meet the condition of Quarantine Boarding and Inspection. The plans were prepared by Cox & Stevens of New York especially of this service.

#### Dimensions of Boarding Tugs

Length over all.....	50 ft. 0 in.
Length load water line....	45 ft. 0 in.
Beam over plank.....	12 ft. 0 in.
Draft aft.....	5 ft. 6 in.
Draft for'd.....	4 ft. 0 in.



*Alaskan trade freight and passenger motorship with 180 hp. Diesel*

2,347 hrs. and 56 minutes under load, 110 hours of which time was at one-half or slow speed during heavy weather. In addition there were  $39\frac{1}{2}$  hrs. of maneuvering, that is, making landings, moving from dock to dock, etc. The longest continuous run was of 9 days 22 hrs. She made a passage of 15 days with 2 stops,  $1\frac{1}{2}$  hours at  $2\frac{1}{2}$  hours respectively but no work was done on the engine at either place. Five to 16 days was the usual length of the longest parts of the voyages and while stopping at various ports at each end all upkeep was attended to.

During the season the ship consumed 24,106 gal. of fuel and 736 gal. of lubricating oil. This lubricating oil total includes all oil thrown away when cleaning out the oil system. A considerable amount would have been saved had the ship been equipped with an oil purifier, probably 80 to 100 gal. The ship also had some oil leaks which were not serious enough to repair, as delay

operates better on 24 deg. fuel than on 27 deg. fuel.

Regarding the troubles which we have had to contend with—says G. B. Poole, her chief engineer—it would be foolish of me to state that we had none as being a practical operating engineer I have yet to see the piece of machinery that is trouble proof especially when working under a strain and often overloaded. However, our delays were very small considering the total number of hours of operation and that most of our ports of call were open roadsteads and it was absolutely necessary to keep the engine in condition to operate at all times. In Northern waters it is not unusual for conditions to arise which make it necessary to get off shore without delay. Capt. Alexander Allan, part owner and commander of the vessel, expressed great satisfaction with the engine's performance several times during the season.

We encountered some very bad storms



The keel is white oak in one piece and the frames are white oak triple sawn for two thirds of boat's length.

One 3-cylinder  $8\frac{1}{2}$  in. bore x 12 in. stroke direct reversible Standard Diesel of 75 hp., built by the Standard Motor Construction Company of Jersey City, N. J., is fitted for propulsion. A 3-blade type Columbia bronze propeller 42 in. diameter x 38 in. pitch is fitted, the revolutions ranging from 150 r.p.m. to 350 r.p.m. giving a speed close to 10 knots. The boats have been named JOHN M. EAGER and EUGENE WASDIN, following a custom of naming service tugs in honor of distinguished deceased officers in the Public Health Service. One tug is stationed at the Baltimore Quarantine Station and the other at the Boston Station.



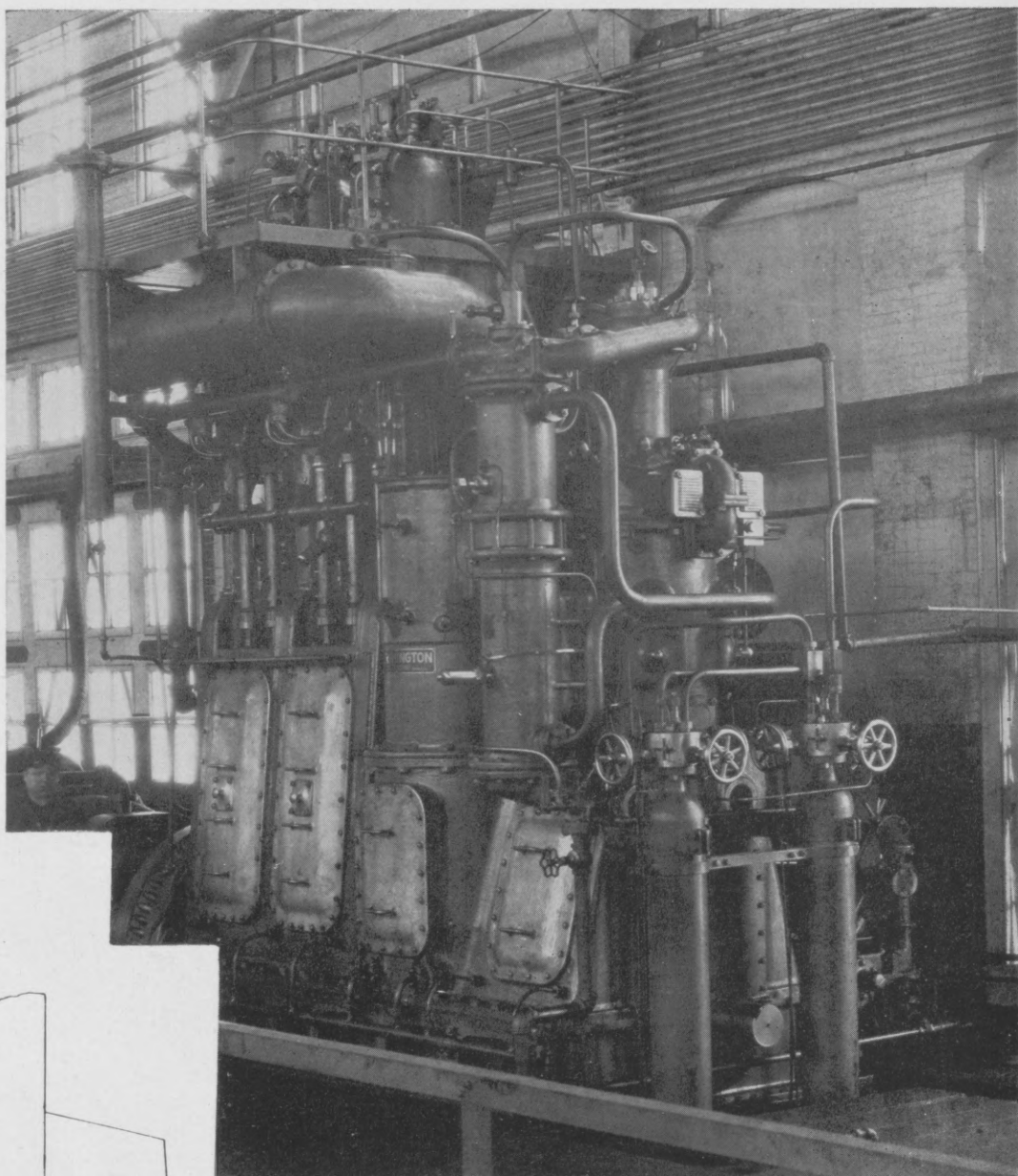
# New York Grain Elevator Diesel Driven

International Elevator Co. Now Operating Powerful 130-Ft. Vessel Propelled and Operated by Worthington Double-Acting Engine

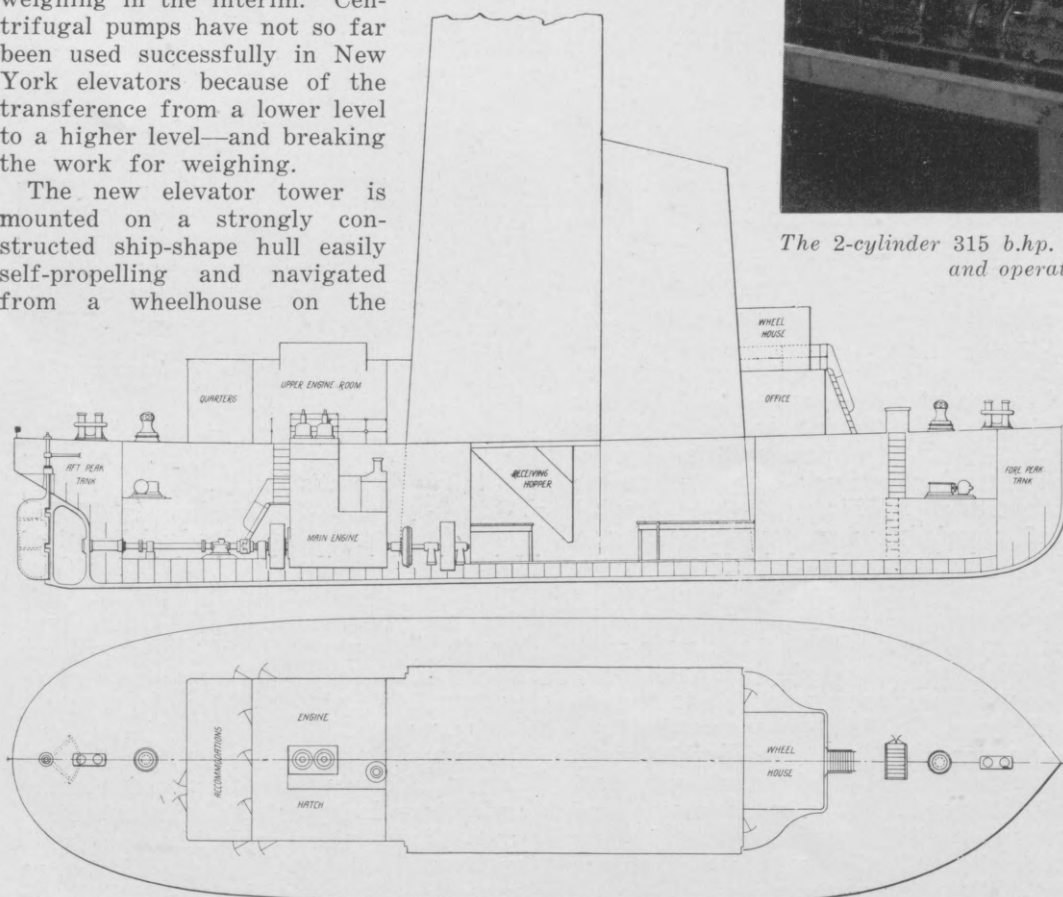
THE Port of New York is one of the busiest water areas in the world and it also probably has represented on its waterways a greater number of ship types than any other port. The so-called grain elevator represents a type to be found in quantities in New York Harbor and in practically no other harbor in the world. There is a reason for this. The New York State Barge Canal which joins the Hudson River at Watervliet, N. Y., is one of the outlets from the Great Lakes and as such handles considerable quantities of grain during the exporting season. Freighters and intermediate liners sailing for United Kingdom-Continent ports are in the habit of filling their holds with grain. Grain comes down from Lake ports in barges, the barges go alongside the ships and the grain has to be transferred from barge to ship. It is for this express purpose that the grain elevator has been designed to transfer grain.

Roughly, it may be said to consist of a series of buckets on an endless belt which dip into the barge's hold and remove the grain to a position where it is sifted and weighed, and finally discharged by gravity down spouts into the vessel's hold. The process is thus the exact opposite of the so-called grain suckers which are used in United Kingdom-Continent ports. These are actually centrifugal pumps which remove grain from the ship's hold by suction and discharge into a barge's hold by gravity. The grain undergoes the process of weighing in the interim. Centrifugal pumps have not so far been used successfully in New York elevators because of the transference from a lower level to a higher level—and breaking the work for weighing.

The new elevator tower is mounted on a strongly constructed ship-shape hull easily self-propelling and navigated from a wheelhouse on the



The 2-cylinder 315 b.h.p. double-acting 2-cycle Diesel which both propels and operates New York's new grain elevator



Outline inboard profile of New York's first Diesel operated grain elevator barge

forward side of the tower. The particular ship we have under review is interesting because it has for propulsion and for actuation of the grain elevating belt a 2-cylinder, double-acting, 2-cycle Worthington Diesel of 315 s.h.p. at 110 r.p.m. This is fitted at the after end of the ship and is direct connected to a propeller at its after end and to a rope drive sheave at its forward end through a clutch. The length of the hull between perpendiculars is 125 ft., and 130 ft. overall. The beam is 35 ft., depth 16 ft., draft aft 11 ft. and forward 9 ft. The elevator is more-or-less self-contained and capable of making protracted journeys from its base to ships in any parts of the harbor.

The hull was built by the Staten Island Shipbuilding Co., Staten Island, N. Y. for the International Elevator Company, Produce Exchange Bldg., New York. The tower and elevating machinery has been assembled by the owners.



# Electrical Auxiliaries on Diesel Tankers

A Comprehensive Note Discussing Various Aspects of the Question With Special Reference to the Gulf Refining Tanker "Gulfpride"

By H. H. Thompson\*

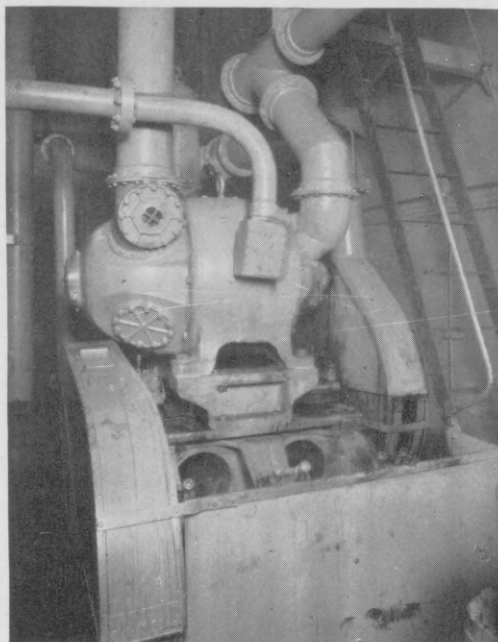
**M**S. "GULFPRIDE," Gulf Refining Co.'s new Diesel tanker, is now operating between Texas and Atlantic ports. She is a new member to that rapidly increasing fleet of big seagoing and coast-wise tankers equipped with a complete outfit of electrical apparatus.

There is probably no other class of ship for which the direct Diesel and Diesel-electric drive is being adopted more rapidly than the tanker, and whether it be a conversion or an entirely new ship, one or the other type of drive is usually selected. The problem confronting the naval architect, shipowner, and shipbuilder, is not so much the type of drive as it is the type of auxiliaries. Either of the above types of drives usually necessitates the use of electrically-driven auxiliaries. Because of the danger of pump-room and cargo-tank explosions on tankers the selection of the proper equipment is of paramount importance.

It is natural, therefore, to find various opinions as to just what is the safest installation that can be made. What is the maximum voltage that should be used? How can the motors and controllers be built so that the sparking and arcing may not be disastrous to the ship? The result is that various types of installations are fitted. Explosion-proof, gas-tight, open and enclosed self-ventilated motors and controllers have been applied. Until just recently there were no definite rules or recommendations governing such installations. Now, however, the American Bureau of Shipping, Lloyds' Register and the Marine Committee of the A.I.E.E. are making definite recommendations which will tend to bring about more uniform installations.

As far as the engine room auxiliaries are concerned, it is generally conceded that with proper ventilation of the engine room

there is no necessity of special enclosures for the electrical apparatus, other than the



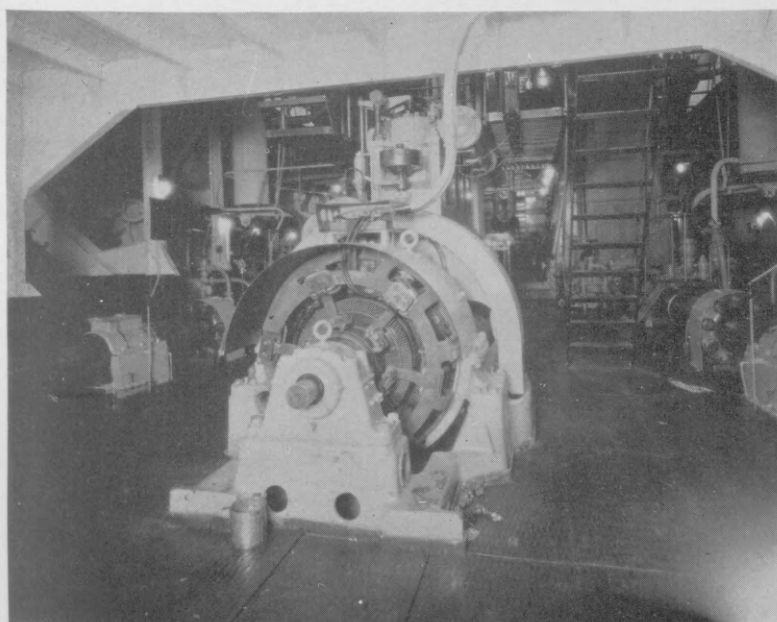
*Electric cargo oil pumps on Ms. Gulfpride*

usual type furnished on cargo ships. With proper attention paid to ventilation the possibility of formation of pockets of explosive gases in the engine room is eliminated. The usual practice is to install self-ventilated motors and controllers with drip-proof enclosures.

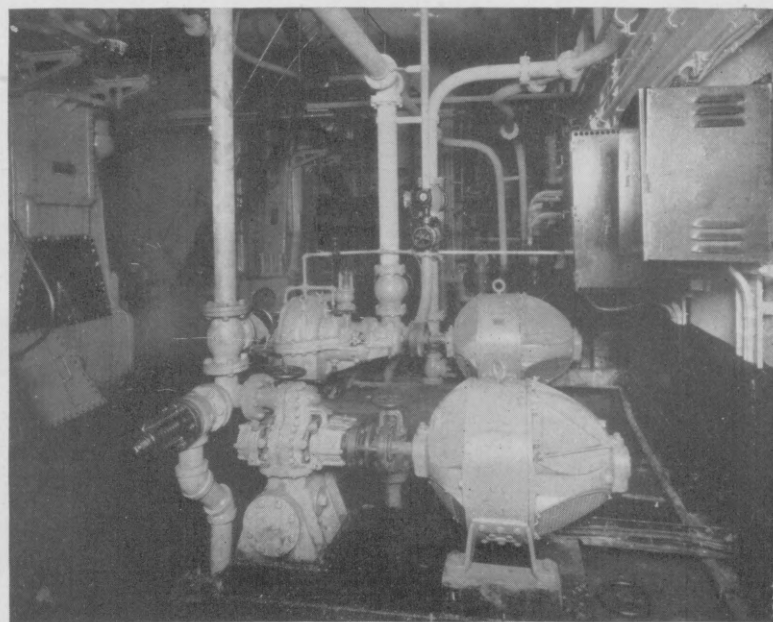
The problem of greatest concern is that of driving the cargo pumps by electric motors. To give an idea of the various types of motor drive and location of the motors with respect to the pumps, the following will be found on tankers operating along the Atlantic and Pacific coasts. On several tankers the pump motor is installed

in the engine room with the motor shaft extending through a gas-tight bulkhead to the pump room where it is coupled to the pump. In such an installation the usual engine room motor is applied, the control for which is magnetic contactor type enclosed in drip-proof cabinets installed in the engine room. On some tankers the motor will be found in a separate compartment adjoining the pump room and separated from the latter by a gas-tight bulkhead. In such installations the motor shaft extends through the bulkhead into the pump room. The motor room is thoroughly ventilated prior to starting and during the operation of the motors. The control is located in the engine room and is of the open panel magnetic contactor type. On a tanker now under construction, the pump motors will be installed in a deck house above the pump room. In this installation vertical open type motors will be used. The motor will be connected to the pump by means of vertical shaft and beveled gears. The control for these motors will be open panel magnetic contactor type located in the engine room.

The installation of the cargo pumps with their motors on the MS. GULFPRIDE will, no doubt, be viewed by many as a bold step to take. A close inspection of the installation will, however, convince one, that the installation is perfectly safe and practical. The engineers of the Federal Shipbuilding Company and the Gulf Refining Company devoted considerable study to their cargo pump problem and are to be commended for the manner in which they solved their problem. In this installation the motors are mounted directly on the pumps and are located in the same room with the pumps, as shown in the picture. The pumps are Worthington plunger type geared to Westinghouse motors. The motors are especially



*A 100 kw. Nelseco-Westinghouse generator set*



*Battery of modern rotary oil pumps in engine-room*

\*General Engineer, Westinghouse Electric & Mfg. Co.



designed for this installation. The frame and brackets are of very heavy construction with wide flanged joints. Glass sights are provided in the hand-hole covers which permit inspection of commutator and brushes without removal of hand-hole covers. These motors were tested for gas-tightness by submergence in a tank of water with relatively high air pressure maintained within the motor. Explosion-proof motors and gas-tight motors were originally contemplated for this installation, but it was finally decided that the safest installation was one in which the motor was not only gas-tight to the extent described above, but also forced ventilated. By this means fresh air is drawn from above deck, forced through the motor and discharged above deck. In order to make this installation doubly safe provision was made in the control necessitating the blower motor to force air through the motor for a predetermined period prior to starting the pump motor. This insures that all gases that may have accumulated in the motor, when not operating, have been blown out. The use of forced ventilation has another advantage and that

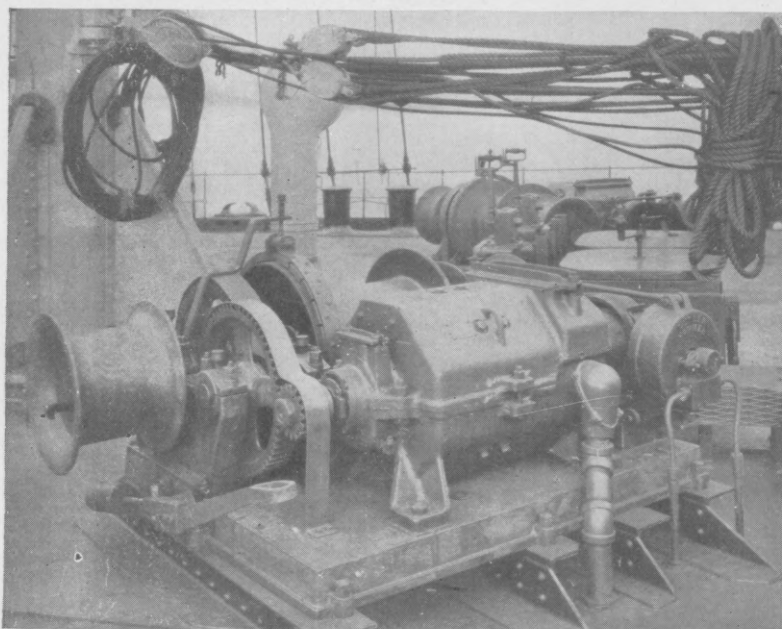
is that during operation the air pressure within the motor is greater than that outside the motor which eliminates the possibility of leakage of explosive gases into the motor. It is believed that this is the first installation of its kind. This type of installation is the safest that can be made where the pump and motor are located in the same compartment.

The engine room auxiliaries are driven by Westinghouse type SK enclosed, self-ventilated motors of the types shown in the illustrations. These motors are especially designed for driving underdeck marine auxiliaries. The windings are especially treated to protect them against the action of water, oil and grease. The bearings are the sealed sleeve type, the latest design in sleeve bearings. They are designed to eliminate the building up of a pressure in one section, which is common to other types of sleeve bearings, with the consequent forcing of oil out along the shaft and into the windings. This design eliminates oil leakage, thereby reducing maintenance costs. By special arrangement of gaskets around the shaft, dirt and other foreign

matter is prevented from entering the oil reservoir. A fan is mounted on the shaft of the motor to draw air into the motor and force it through in the most efficient manner, thereby insuring proper ventilation. The ventilating air is drawn in through the openings in the rear bracket and exhausted through the openings in the front bracket. The openings in the commutator end bracket permit easy access to the brushes and the commutator, eliminating the brushing aside of leads to permit one reaching the brushes.

The deck motors are the Westinghouse type MC, and are strictly water-proof. They are of rugged construction and are especially designed for the severe service encountered in cargo winches, windlass and capstan applications. They are noted for their great overload capacity and practically sparkless commutation throughout the range of loads. This type of motor is shown.

Power is supplied to the auxiliary motors by three Westinghouse type Q generators. The generators are rated 100 kw., 240 volts, and are driven by Nelseco Diesels.



*Electric cargo handling winch*



*Electrically operated hydraulic steering gear*

## Big Motoryacht With Opposed-Piston Diesels

**M**S. SIALIA 550 gross ton yacht was built in 1913 at Wilmington, Del., as a steamer of 1200 hp. and was later converted to Diesel power. She is a fine-looking vessel with a clipper bow and graceful counter stern, and has a length b. p. of 200.6 ft., a beam of 27 ft., and a depth of 17.3 ft. Henry Ford is her owner.

When the owner of the yacht decided upon a reconstruction program, he had in view two different conclusions—increased accommodations for the guests and also the crew, and a new type of motive power which would give increased speed and reduced vibrations.

A very careful and exhaustive consideration was given to the type of motive power, and it was decided to use two sets of Sun Doxford high speed engines. With a view of making a compact installation that would work with smoothness, it was decided to build both engines on one bed plate.

The engines were constructed as are shown in the illustrations and it might be well to remember that the builders used very freely aluminum alloy especially developed for this purpose, of a strong durable quality, with the result that the engine weights were kept down remarkably low, which was most desirable in a light steel hull of this description.

The use of aluminum alloy in many parts of the engines, such as casing doors, casing tops and other more important parts of the structure, turned out to be of great advantage for the reason that the men could handle these parts more expeditiously with a less number of men. The material being of such a fine texture, took on a polish and finish that could not be looked for in ordinary castings.

The results of the running of the vessel during trial periods and over a whole season, disclosed that the vessel had improved

speed very materially and was entirely free from vibration, and operated at a very low expenditure as to fuel and lubricating oil.

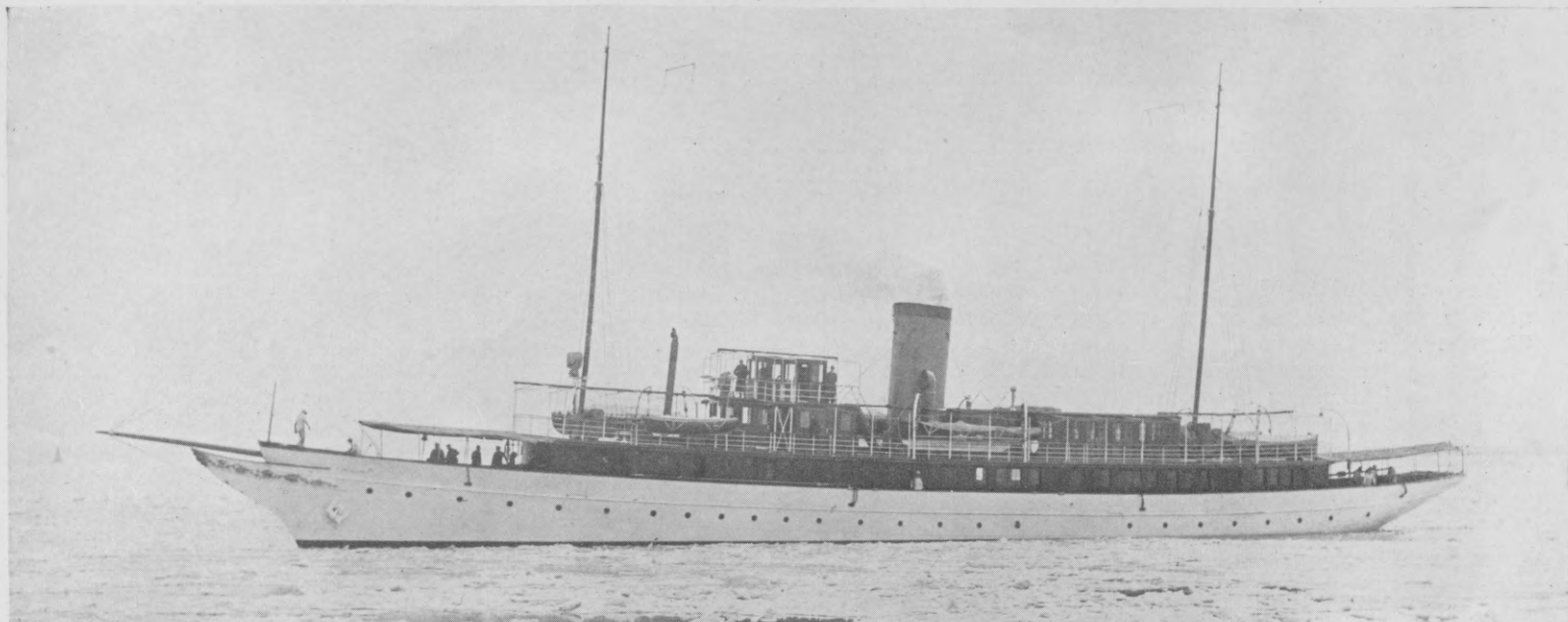
It was difficult to know that engines were in operation, unless one stood close to the engine room and looked inside. The Sun Doxford type of engine is a remarkably quiet running engine, still in this case it was very noticeable and, of course, very highly appreciated in a vessel in which the living conditions are brought up to the finest pitch.

This is the first yacht that has been so equipped with twin screw Sun Doxford engine, and we understand it has proven a remarkable success.

The engines are each 6-cylinder units of 750 s.hp. each. Each cylinder has a diameter of 13 in. and a stroke of 17 in. by 21 in. The two engines have a length of 31 ft., and a weight of 197,000 lbs. each.



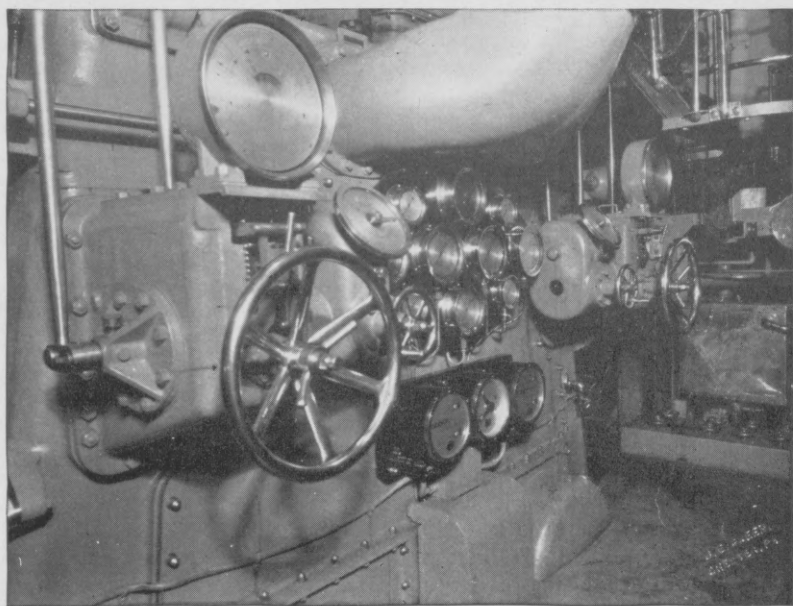
# Ford's Motor Yacht with Sun Twin Opposed-Piston Diesels



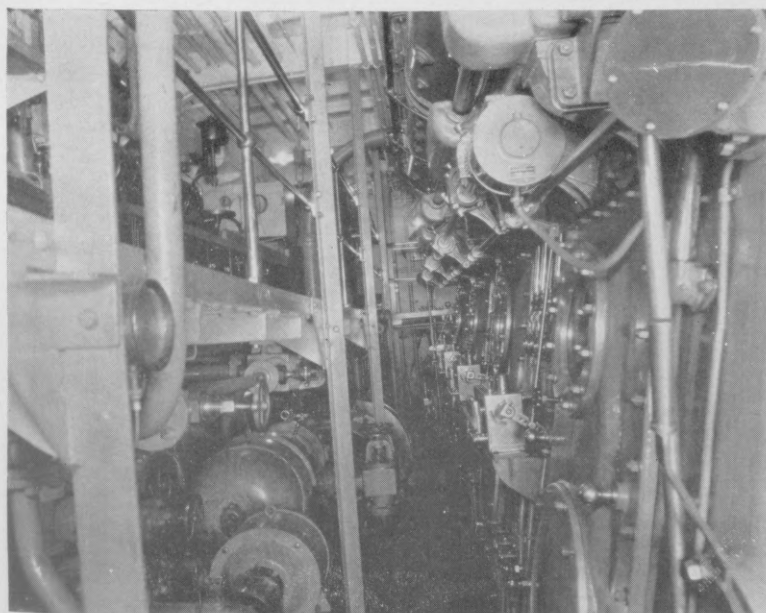
*Motor Yacht Sialia was built as a steamer, but for the better comfort of her guests and for economical working Diesels were substituted*



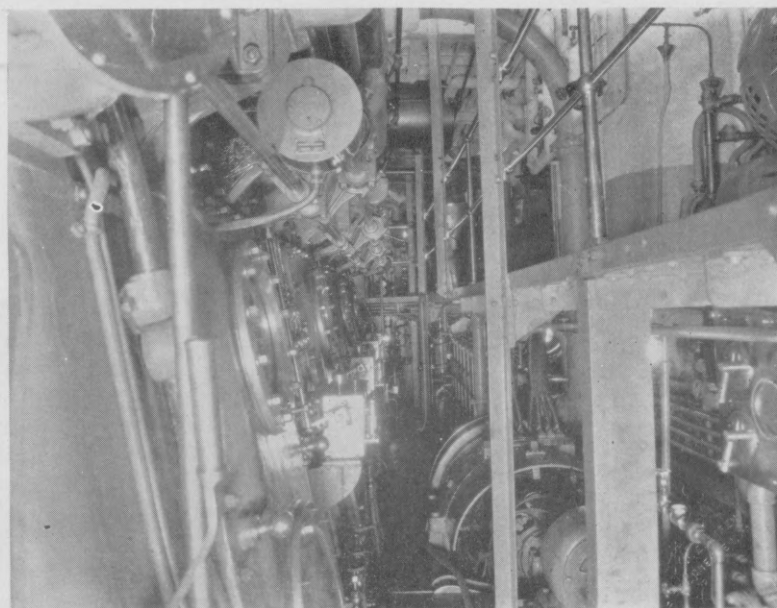
*Twin screw Sun-Doxford Diesels on common headplate*



*Controls for the two engines*



*Outboard side of one main Diesel*



*Auxiliary generator sets in engine room wing*





# Motorshipping Marks New Era in Sea Transportation Business.\*

Summarizing the Reasons for the Development of Motorshipping,  
Quickly in Some Directions, Slowly in Others, in  
Terms of the Shipowner and His Advisors.

IF the statement that motorshipping marks a new era in the business of sea transportation is correct, an examination of some of the facts underlying such a statement will reveal reasons why the motorship has reached a state in its development where there is more Diesel tonnage than steam tonnage under construction throughout the world. It will show also why in some directions the oil engine has made more progress than in others; why it has practically absorbed some types of ships, and how, in consequence, it has had a profound influence on their design, and why also it has left very little impression on others.

To assess reasons for the development and progress of a particular basic idea in engineering—such as the Diesel engine unquestionably is—may not be as easy as would at first appear because all sorts of unknown factors enter, factors of a psychological rather than of a material nature. For after all, in the last analysis, it is the shipowner rather than the engineer and the naval architect whose mass opinion is the factor with which the progress of motorshipping varies directly.

Treated as a purely psychological study the success of motorshipping may be regarded in much the same way as the problematic success of a play or of a book. Some books and plays are successes, just because they are successes. Others again, are tremendous successes—for the same intangible and uninterpretable reasons. They just catch us and having caught us, they run and run. Moreover, once they are definitely established as successes, their momentum carries them on. How many people, for example, read, "Elmer Gantry" because it was a talked-about book too good to be missed. "Elmer Gantry" while universally read, was widely criticized because it reflected a freedom of thought, and it

\*No. 6 of a series of articles especially designed for those who desire a concise summary of motorships in relation to sea transportation.

was in the main an effective picture because it required a deviation of the brain from the accepted path of thought.

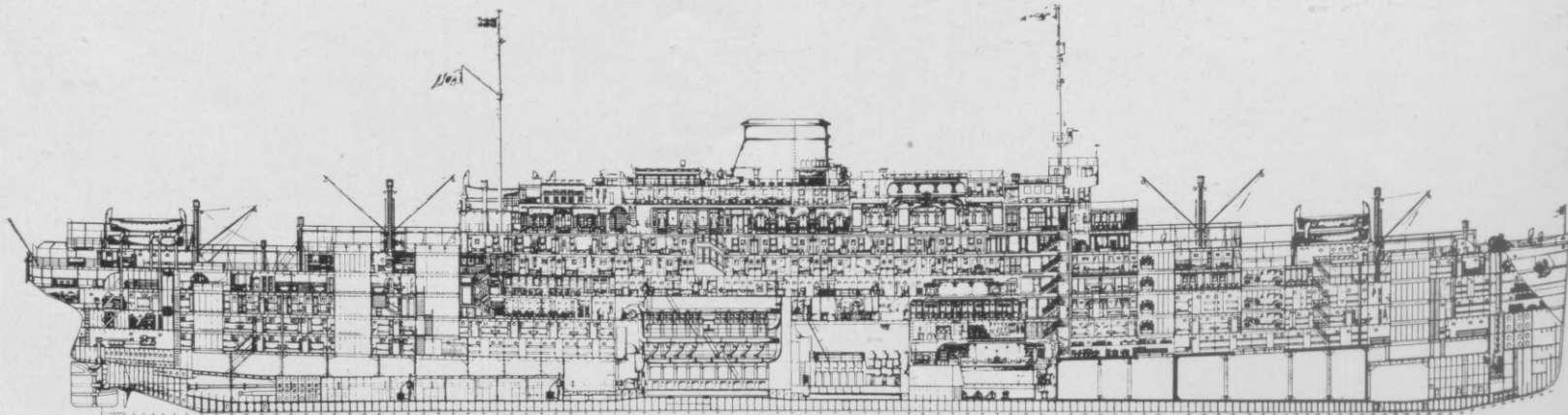
So, too, we can to a certain extent apply the book analogy to motorshipping. In the first place its momentum is now sufficient to carry it on. It cannot be stopped! In the second place it definitely demands new thought in every way and at every turn. Lack of realization of this proved one of the biggest retarding factors in its progress. Lastly we may be assured

## MORE MOTORSHIPS THAN STEAMERS

*More motorships than steamers are now under construction throughout World shipyards... Why? One enthusiast may say, "Naturally, because of the superiority of the Diesel engine over the steam engine!" That is not all, however. There are many other reasons, some of which are difficult to determine. There is the type "P" mind, and the type "A" mind, one retarding and the other advancing.... This article, the fifth of our series, is the first attempt to get at the back of the motorshipping movement and to sum it up in terms which are psychological as much as material. It is at once helpful and suggestive to builders and manufacturers.*

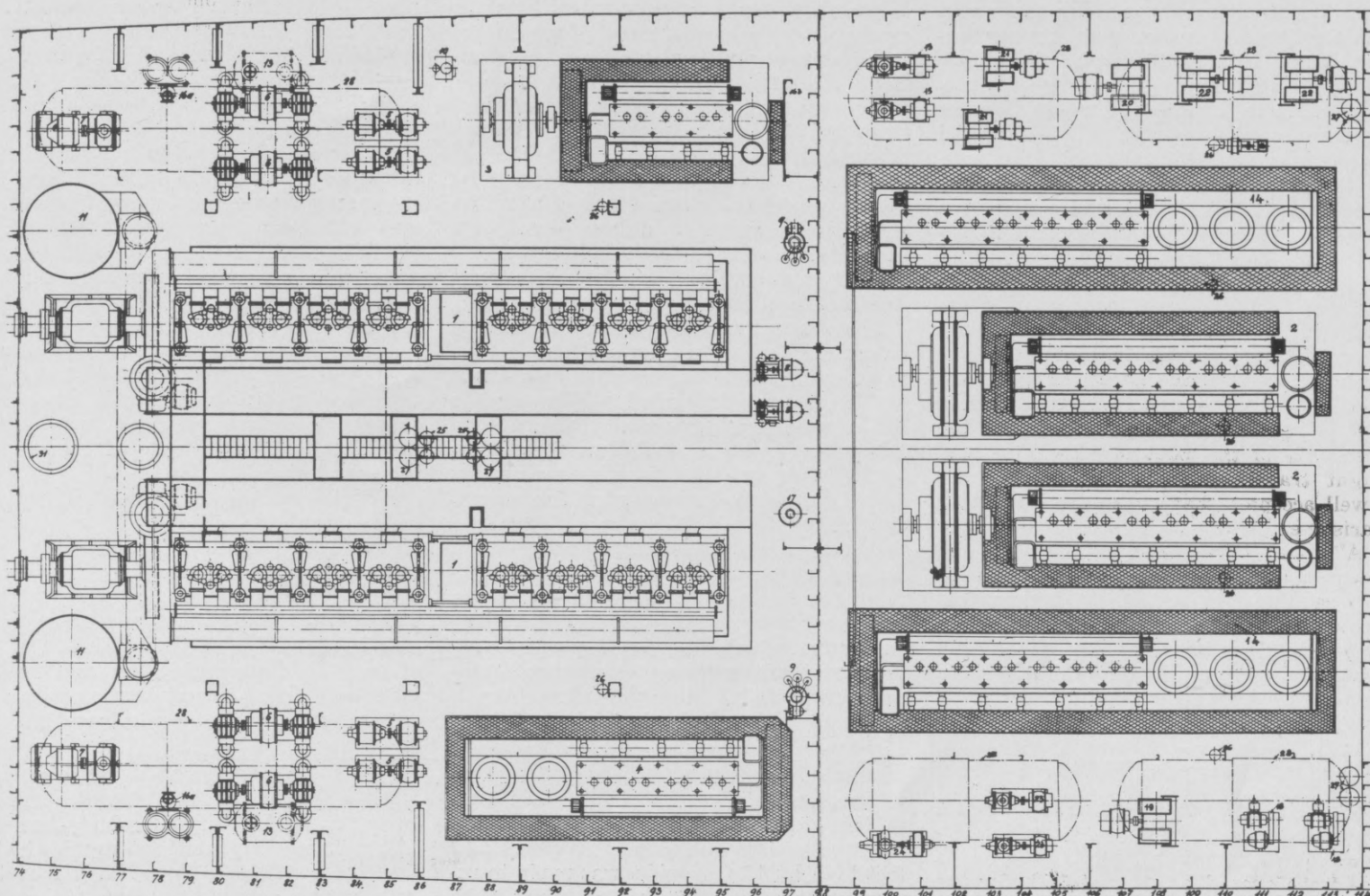
that the success of the motorship is not due entirely to something ephemeral—as with a play or a book—but rather that its success is in the main evolution—that same evolution which has led to the gradual replacement of the sailing ship by the steamer. It is a success in which hard economic and sound engineering sense have played about equal parts. You cannot arrest the path of evolution.

We have said that the momentum of the motorshipping movement is now sufficient to carry it on. This may be expanded further into the suggestion that no one in the shipping world at the present time can afford to ignore the possibilities of the Diesel engine. We may say even further that no one is ignoring the Diesel. It is surprising on investigation to find how deeply the question of motorshipping has been investigated by some shipping men who, on the surface, are apparently wedded to steam. If the Diesel engine had no self-momentum, the ultra-conservative shipowner would ignore its existence completely. He does not ignore it because his brother shipowners are investigating and he feels he may lose something by non-investigation. According to theory, having investigated, the shipowner should at once fall for the Diesel. Why doesn't he in every case? This is an important point. It is impossible to assess a reason to cover every case. There are separate reasons applicable to each and every case. One is, however, common to about 75 per cent. of cases, and that is, Ignorance of the Diesel. Coupled with this are two sub-reasons, bad advice and mental inertia on the part of advisers. Absence of close study over a period of years often leads him astray in his delayed investigation. There is, for example, the case of an owner of a large fleet of coastwise ships who became the possessor of a fine yacht in which were fitted two 800 h.p. Diesels. In discussing with the manufacturer of the engines the characteristics of his motor-yacht he said, "Tell me, Mr. —, are Diesel engines suitable for my coastwise ships?" The manufacturer intimated vigorously that coastwise ships were just precisely what the Diesel engine in general, and his own particular engine in particular, was suited to. "Then why," said the shipowner, "haven't my advisers told me of this?" Reason one, Ignorance of the Diesel.



The attitude of the "A" mind to progress is to be found in the above sectional plan of two large passenger motorliners now completing for the Cosulich Line. This development involves tremendous strides in engineering, and technical mistakes would entail huge financial loss





It takes an "A" mind to plan such a radical departure from conventional steam engine room practice as this machinery space of the Cosulich Line's big passenger motorliners, "Saturnia" and "Vulcania." In each vessel the two main Diesel engines are of 10,000 hp. All equipment is electrically operated by power from Diesel-driven generators

Shipowners are extremely busy men. That's why they employ trained advice in the shape of superintending-engineers, marine-superintendents, and consulting naval-architects and marine engineers. Time was when many shipowners were either seamen or ex-seamen and, with the small fleets then in existence, they could take care of all their own technical needs. The shipowner of today would require to be a species of superman to have a detailed grasp of the many departments into which modern ship operation is segregated, and especially of the mechanical side. That is why he employs his specialist.

Many of the specialists coming under the superintendent group are men with the accumulated knowledge of a lifetime spent at sea and among ships. Their knowledge, deep and valuable, is accumulated rather than assimilated. Notice the difference between the two. A man accumulates knowledge with years, as a large snowball gathering momentum in running down a hill gathers fresh flakes. He accumulates from his actual contact with working conditions and thus builds up a definite synthetic knowledge. It is a passive synthesis because, with an average intelligence, the knowledge builds up willy-nilly and no great application of brain power is necessary. Call this the "P" mind.

Alongside the synthetic or accumulated knowledge we have the active mind, which, in addition to gathering its store of knowledge as it inevitably must, reacts to new ideas, seeks out new thought and investigates new developments. Call this the "A" mind,

and apply both types of mind to the question of motorshipping.

The "P" mind having been brought up upon and nurtured by steam, prefers to remain in a more or less state of repose where new thought is concerned. Since the Diesel engine demands intensive study as well as a very live mind for the perception of the changes which the engine brings in its wake, condemns on hearsay rather than investigates. The "A" mind, on the other hand, from the beginning designed to accept new ideas, is willing to investigate the Diesel engine from all angles in its possible application to ships.

There are still too many "P" type minds in the world of ships and shipping at the present day. It was a "P" type mind which, when the designs for a new large motorship were being considered, refused to place the crew anywhere but in the fore-castle because, in the owner's synthetic experience, they had never been anywhere else. It was a "P" type mind which made the announcement, on being asked whether he had ever considered Diesels for a certain fast ship, that if he had used Diesels there would not have been room for anything else in the ship. It later transpired that he had based his opinion on the dimensions of a certain type of slow-speed engine whose designers, in their wildest dreams, would never have suggested it for express passenger service.

It was, on the other hand, an "A" type mind which, in converting a steam tanker to Diesel drive, offended tradition by removing the entire bridge structure from its

time-honored place amidships and arranging a navigating position at the fore end of the poop. The ship has pilot-house control anyway, so why worry! This same type "A" mind, if his new pilot house doesn't prove successful, will return it to the old place again. In the meanwhile, the rivets on the poop deck are good strong ones.

And now to return to our friend the shipowner. If the progress of motorshipping varies directly with the mass-opinion of shipowners, then the mass-opinion of shipowners is a variable of the influences of type "A" and type "P" minds. If we can eliminate our type "P" minds, will the success of the motorship be so assured that steam must immediately go out of business? The answer to this is yes and no. Possibly rather more "yes" than "no", but remember that, even if the type "P" minds are outside the pale of reasoning and instruction, which is extremely doubtful, the type "A" minds have to be thoroughly sold on the superiority of the Diesel in all its applications before they will give judgment. This judgment, when given, will be sound because of the receptive ground from which it springs and by reason of the thorough study first made.

We may now take stock of the situation as laid out for us at the present time by the "A" type minds, because they are the people who by their reaction on the shipowners have determined the present position of the Diesel-engined ship, a position in which a greater proportion of tonnage



under construction throughout the world is motorshipping tonnage than steamer tonnage, aside from conversions. Big ship-ping combines such as are now in existence, are tending to favor liner construction for the transportation of freight and the old time tramp, while actually not disappearing is diminishing in numbers. The liner is naturally a finer, all round proposition than the tramp. It has refinements of fittings, as it only requires to be designed for one particular service and its owners are able to spend more money upon its equipment. At the same time economy of operation is an important feature and the advantages of the Diesel have not escaped the "A" type minds for that type of work. It is almost useless to reiterate the superiority of the motorship for long haul freight transportation. The fact is now so well accepted that reiteration is almost wearisome.

"A" type minds are approaching the Dieselization of large passenger liners with more caution, because of the bigger, less known problems involved but until the last few years this caution has been engendered rather by the position of development of the Diesel engine than by lack of interest or enthusiasm. The "A" type mind

is definitely ready to accept new ideas as we have suggested before, but the engine manufacturer must put up a good proposition. Nothing will ever be gained by manufacturers who place on the market anything but the best. Over-rating of engines or exaggerated guarantees help no one. At the present time manufacturers and those vitally interested in Diesel engine progress are busily engaged in driving home to a number of obdurate "A" minds and in attacking numerous "P" minds on the question of Dieselizing coastwise shipping.

The Australian coast is an outstanding example of what can be accomplished in this direction. What we have said about "P" minds and "A" minds applies also to the actual operating staffs on board ship. It applies, however, with less force than to the advisory staffs, because presumably "A" type minds are selected for motorship duty initially. Remember, however, that many a motorship has been damned in the eyes of her shipowners because of inefficient or inexperienced operating crews. In the early days of this development many an engine which functioned perfectly on the test blocks with an experienced technical crew, failed miserably when operating in the ship. This should be a definite

lesson to designers to design simply. Then there is the story of the engineer on one of the very early motorships with 4-cycle machinery who thought, during his naturally brief regime, that he was operating a two-cycle engine—and of the man who put his controls "full astern," when the order from the bridge was "full ahead."

Generally speaking, navigating officers are enthusiastic over the maneuvering qualities of the Diesel. In fact, the navigator is one of the motorship's foremost friends. Maybe he is storing up experience for the time when, with pilot house control, and all the other refinements of modern electro-navigation the man below and the man on the bridge will have interchangeable functions. This looks a long way ahead but appears to be a logical development.

Educate and illustrate must be the definite keynote to all campaigns of attack on "P" minds and of consolidation with "A" minds. Manufacturers must discuss their failures along with their successes. Exaggerated rumors do more harm in the case of the "P" mind than plain statements of facts, and motorshipping still needs a lot of explaining to people who cannot, will not or have not the time to investigate.

## Hydraulic Dredge for New York State Canal

Bids were opened on August 15th for the Diesel engines for a dredge to be built for the Division of Canals & Waterways of the Department of Public Works of the State of New York at Albany. The dredge, which is to be built under the supervision of T. F. Farrell, Commissioner of Canals & Waterways, will have her main machinery driven by Diesel engines. There is one engine of 500 b.h.p. direct connected to a 15 in. centrifugal dredging pump, and a 150 b.h.p. Diesel engine direct connected to a 100 kw. generator. The machinery contract was awarded to the Bessemer Gas Engine Co., of Grave City, Pa.

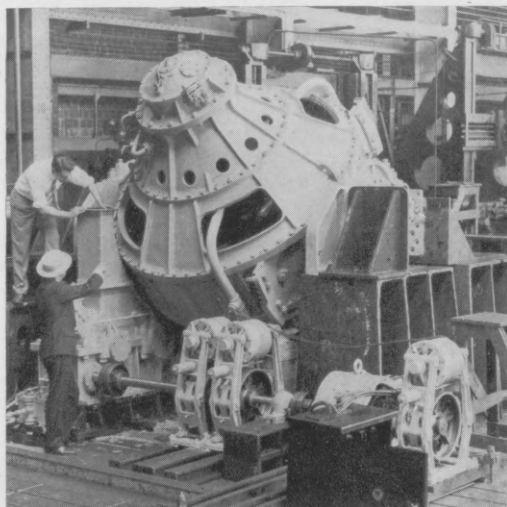
Specifications call for Diesel engines of the 4-cycle, single-acting type in six or eight cylinders for the main engines and four or six cylinders for generating engine, the rated capacity to be at 275 r.p.m. Maximum fuel consumption must not exceed 0.46 lb. of oil per b.h.p. hour, while the lubricating-oil consumption must not exceed 0.0015 lb. per b.h.p. hour.

It is noted that the engine contractors shall furnish one 12 hp. auxiliary Diesel engine as manufactured by the Hill Diesel Engine Co. of Lansing, Mich., or equal, connected through multiple disc clutches to a 2-stage air compressor, to a 4 in. centrifugal pump and an 8 kw. generator. The dredging pump will be required in the test to deliver 7200 gal. of water per minute through 1500 ft. of 15 in. discharge pipe, the outlet of the pipe being 40 ft. above the center line of the pump.

## Gyroscope For Big Yacht

Tests were recently conducted on the new gyroscopic ship stabilizer built at the Westinghouse Electric & Manufacturing Co.'s South Philadelphia Plant, to the design of the Sperry Gyroscope Co., for the big Die-

sel yacht, now building at Wilmington, Del., to the order of Richard M. Cadwalader. During the test, the stabilizer, which is 9 feet high by 10 feet wide, was made to respond to the conditions which it would be



Sperry gyro for the yacht *Savarona II*

put to in bad weather at sea. The rotor was seen to rotate at 1300 revolutions per minute. The stabilizer was precessed fore and aft in its bearings just as it will to counteract the roll of the ship.

This stabilizer will go a long way toward the prevention of sea sickness as it will eliminate all disagreeable roll in bad weather. As previously recorded in *MOTORSHIP* the new yacht is of 2300 tons Y.M., and will be equipped with two 1500 s.h.p. Bessemer engines. Complete Sperry gyroscope navigation equipment will be installed, including the "Metal Mike."

## Hamburg-American Line New Motorship Fleet

In the August issue of *MOTORSHIP* particulars were given of the new liners, *St.*

*LOUIS* and the *MILWAUKEE*, which are now being built for the Hamburg-American Line. These ships are noteworthy in that they both will be equipped with four two-cycle, double-acting Diesel engines of 3050 b.h.p. each turning at 239 r.p.m., and driving twin propellers through reduction gears at 110 r.p.m., giving the ships a speed of sixteen knots. The *St. LOUIS* and the *MILWAUKEE* will carry a total of 1150 first, second and third class passengers.

Altogether the Hamburg-American Line is constructing eight motor ships of three different types, having a total aggregate tonnage of 86,000 tons. The second group consists of four 9000 tons 14 knot motorships, of the names *SAN FRANCISCO*, *LOS ANGELES*, *PORTLAND* and *SEATTLE*. They will be of the combination freight-and-passenger express type. They are of particular interest in that each will be equipped with the new Hesselman three cylinder, two cycle double Diesel engine.

The third group will be ready in March and July of 1928 and will be two vessels of 9600 tons each, named the *RIO ORINOCO* and *RIO MAGDALENA*. They will have Diesel engines of 6000 horsepower, and will have a sea speed of sixteen knots. Accommodations will be provided for 250 first class passengers and a limited number of intermediate class, and the vessels will be placed in the Hamburg-West India-Mexico service, as well as in occasional Polar and West Indian cruises. The United American Lines of New York will act as agents.

Information has also reached us that in the near future a big motorliner of 36,000 b.h.p. in twin screws will be built for the Hamburg-New York service. Two A.E.G.-B. & W. Diesels will be installed.

## Seventy-five Per Cent Diesel

Of 150 tankers now building 75% are being equipped with Diesel propelling power. Oil companies believe in economy!



# "One Man" Diesel Tugs in Canadian Waters

Vancouver Builds Baby Tugs of Minimum Size with Maximum Power to Circumvent Tonnage Rules for Small Craft

IN Canada there is a regulation that any commercial power craft over 5 tons gross measurement, with the exception of fishing vessels must have a certified captain. In consequence, in British Columbia a large fleet of mosquito craft has been developed for harbor towing and other work, measuring just under 5 tons. These vessels may be operated by one man, and he does not require to hold any certificate whatever.

There is no practical way of beating the gross measurement rule, and about the limit of size for a baby tug is 32 feet over all by 9 feet beam and 4 feet moulded depth. If more moulded depth is required, the length or beam must be reduced.

However there is no limit on the power that may be installed; and the tendency now seems to be to give them all they will float. In the past, gasoline engines have been largely used in these boats, and with high speed engines combined with reduction gears as high as 100 hp. has been installed in one of these little craft, though she is not normally operated to develop the full power.

During the last 2 years a number of oil engines have been installed in these little craft on account of their fuel economy, and the ability to develop full power continuously under the heavy duty conditions of long sustained tows; and last winter the first full Diesel, a 50 hp. 3-cylinder Atlas-Imperial Diesel engine has been installed in one of these little tugs.

Nelson Spencer Ltd. of Vancouver, B. C., had this baby tug ALLAN S. designed and built for harbor log towing in connection

with a timber export business. Her dimensions are 30 ft. o. a. by 8½ ft. beam and about 4 ft. 9 in. moulded depth, and about 5 ft. draft.

The hull is sturdily constructed with 1½ by 2¼ in. steam bent oak ribs spaced 9 in. on centers, and 1½ in. fir planking, in full lengths. Stem and sternpost are gumwood, and the 7 in. by 8 in. keel is fir. The engine bed is constructed of 8 in. by 10 in. fir timbers; while stringers, deck beams, etc., are heavy in proportion.

The layout is of the conventional type developed for this class of boat, there being a fairly high trunk cabin over the engine; and the pilot house aft, having all the engine controls within reach of the steering wheel, so that she can be operated by one man.

A 3-cylinder 50 hp. Diesel engine, weighing about 9000 lbs., is about as heavy a machine as it is desirable to put into a hull of this size. It develops its rated power at 400 r.p.m. and swings a 40 in. diameter by 32 in. pitch propeller with three blades. When first put into operation a good deal of vibration was noticed, but this has been corrected by tying the top of the engine to the deck timbers at each side with heavy turnbuckles, so that it now operates remarkably smoothly.

The auxiliary compressor plant is installed forward of the main engine, with just comfortable room for the engineer to work between them. As he operates the boat as well, he does not spend much time in the engine room apart from starting up, and an occasional look at the oiling. The fuel tanks have a capacity of 180 gal., and

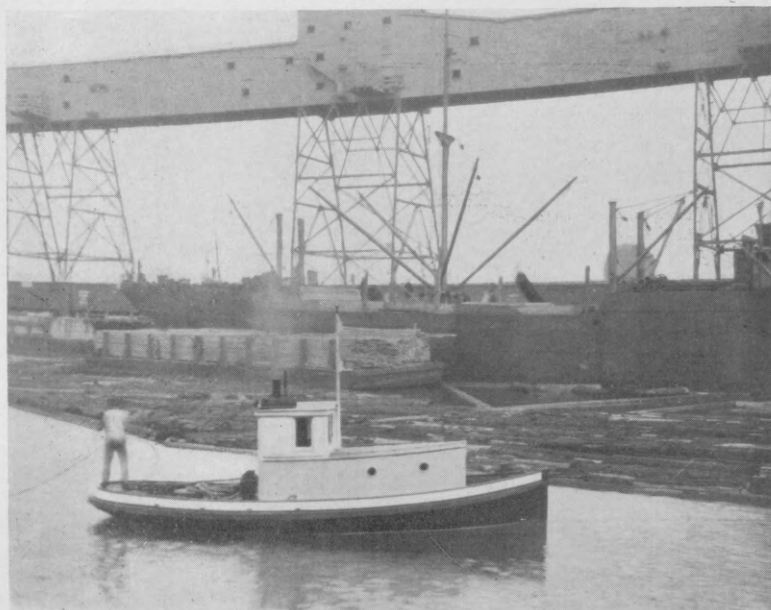
some additional ballast is carried to trim the boat by the stern.

With a clutch reverse and an exceptionally big rudder, she maneuvers very easily, and is proving very convenient for single handed work. Occasionally when a large boom has to be yarded out a second man is carried as she will tow six or eight sections of logs with ease, and probably a good deal more in smooth water.

The Capilano Timber Co. of Vancouver, had a similar type of boat built early in 1926, having a hull 30 ft. o.a. by 9 ft. beam, and equipped with a 45 hp. Fairbanks, Morse oil engine. This tug is used in connection with their saw mill, and is reported doing good work towing logs.

While these two boats are being used for harbor work, three other small craft of the same type, the WEE MAC, WEE GIANT and WEE SCOTT, operated by D. C. McGregor and associates of Vancouver, B. C., have sometimes been used on the west coast of Vancouver Island, occasionally making long runs in the open sea; and on other occasions also are said to have behaved themselves very well in rough weather though most of their towing is done in protected waters. They measure 32 ft. o.a. by 8½ ft. beam, with 5 ft. draft, and are all equipped with 36 hp. Gardner oil engines, some of direct reversing type, and others fitted with clutches.

While various other small work boats are using oil engines these are a fairly representative example of what can be done in the way of powering a one man boat with such prime movers. They point to get another outlet for Diesel builders' activities.



The "one man" tug used in Vancouver



Baby tug engaged in log towing

THE honor of opening the new Songhees drydock at Esquimalt, near Victoria on Vancouver Island, B. C., was conferred on MS. CHALLAMBA when eventually

she reached Victoria after being salvaged from the reefs at Whitecliffe Island. The new graving basin is one of the finest on the Pacific coast and cost \$6,000,000 to build

and equip. It was opened on Dominion Day, by Chief Justice J. A. MacDonald, administrator of the province and is a valuable aid to shipping.



# Re-Engining the Fruit-Carrier La Playa

Larger Horsepower, Consisting of Four 950 b.hp. Fiat Cross-head-Diesels, Installed in This American-Owned Diesel-Electric Propelled Ship

IN the August issue of last year, we published the decision of the United Fruit Company of Boston, Mass., to re-engine the LA PLAYA which, together with her sister fruit-carrying vessel LA MAREA, was built by Camellaird & Co., Birkenhead, England, during the summer of 1923. The LA PLAYA and her original machinery installation was extensively described and illustrated in our November and December issues of 1923.

It will be remembered that the LA PLAYA was originally equipped with four 825 b.hp. at 250 r.p.m. Camellaird-Fullagar two-cycle, opposed-piston Diesel engines, each directly connected to a 500 kw. main generator and a 200 kw. generator, both being d.c. 220 volt, operated at 250 r.p.m. The main electric propelling motor was originally rated 2500 s.hp. at 100 r.p.m., and is installed in a separate water-tight compartment at the after end. The vessel is extensively equipped with electric driven deck and engine-room auxiliaries, including two carbon dioxide refrigerating compressors.

The four main generators are connected in series on the Ward-Leonard system whereby the voltage is increased, as the current flows through each generator, up to a maximum of about 880 volts. Speed regulation is obtained by varying the field excitation, current for this purpose being furnished by one or more auxiliary generators which are all connected in parallel. At reduced power one or more main unit is cut out as may be desired.

The main consideration which led to the adoption of the Diesel-electric machinery in these vessels was the large refrigerating and auxiliary load amounting to approximately 400 kw. or nearly 22 per cent of the power required for propulsion, which necessitates operating one main unit in port at about 75

per cent of its rated power when the cargo holds are being cooled prior to loading. It may also be mentioned that by placing the switchboards and electric control on a flat above the generators and by super imposing the refrigerating machinery on a second flat above the

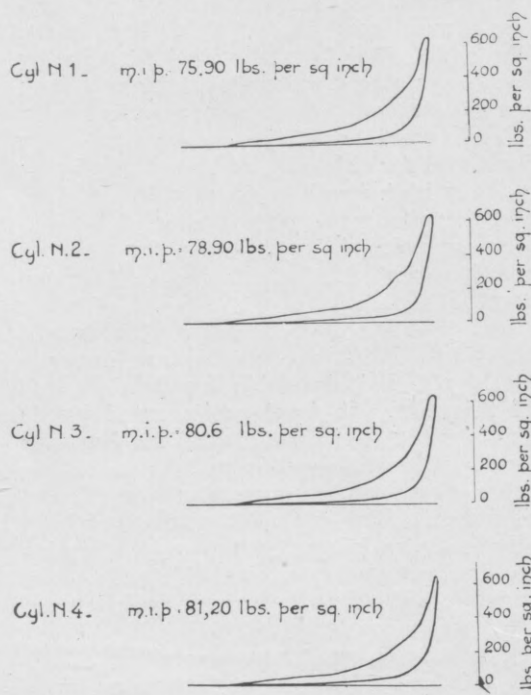
switchboards, the length of the engine room was materially reduced and the cubic capacity of the vessel increased by some 32,000 cubic feet above what might have been obtained with a direct Diesel drive.

It may also be mentioned that the air coolers for refrigerating the forward holds are located on the cargo side adjacent to the forward engine-room bulkhead which is also heavily insulated.

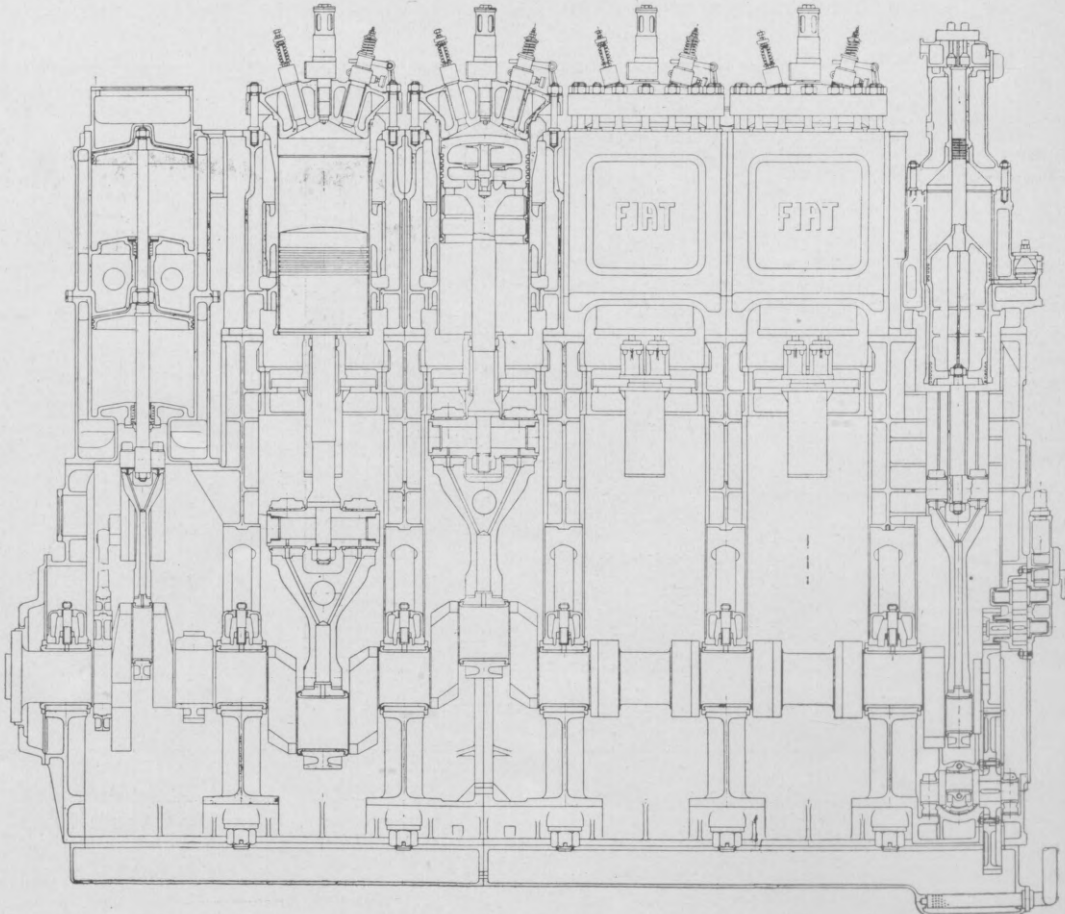
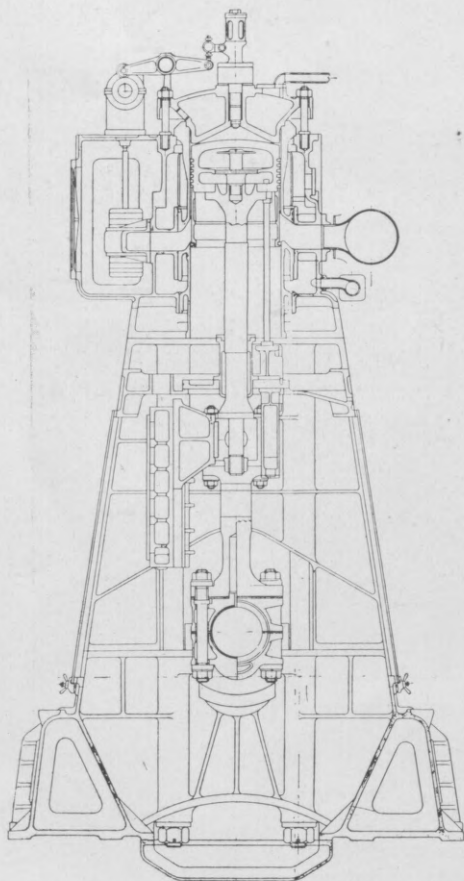
The experience gained during the construction and operation of the LA PLAYA and LA MAREA was presented last November before the Institution of Engineers and Shipbuilders in Scotland by D. N. Shannon, the designer of the original engines, in a paper entitled "Marine Oil Engines," from which we quote as follows:

"Cinematograph records taken from the electrical instruments showed that there was often an increase of 50 per cent in the power required by the main propelling motor when the ship was pitching and rolling heavily. In the case of a direct oil-engine drive to the propeller, the only effect is to slow down the engine, when the torque suddenly increases as the propeller falls back into the water. The engines do not suffer from overloading, since the fuel-valve lever is at a definite setting. The matter is quite different with constant-speed engines under the control of a governor that keeps on attempting to increase the power to meet the heavy momentary overload. It is, therefore, necessary with Diesel-electric systems to have a good margin of power in the generator engines."

The fact is corroborated by the operation of the United Fruit Company's steamer SAN BENITO, which is propelled by a 3000 s.hp. induction motor actuated by a turbo driven a.c. generator. In heavy weather, the ammeters

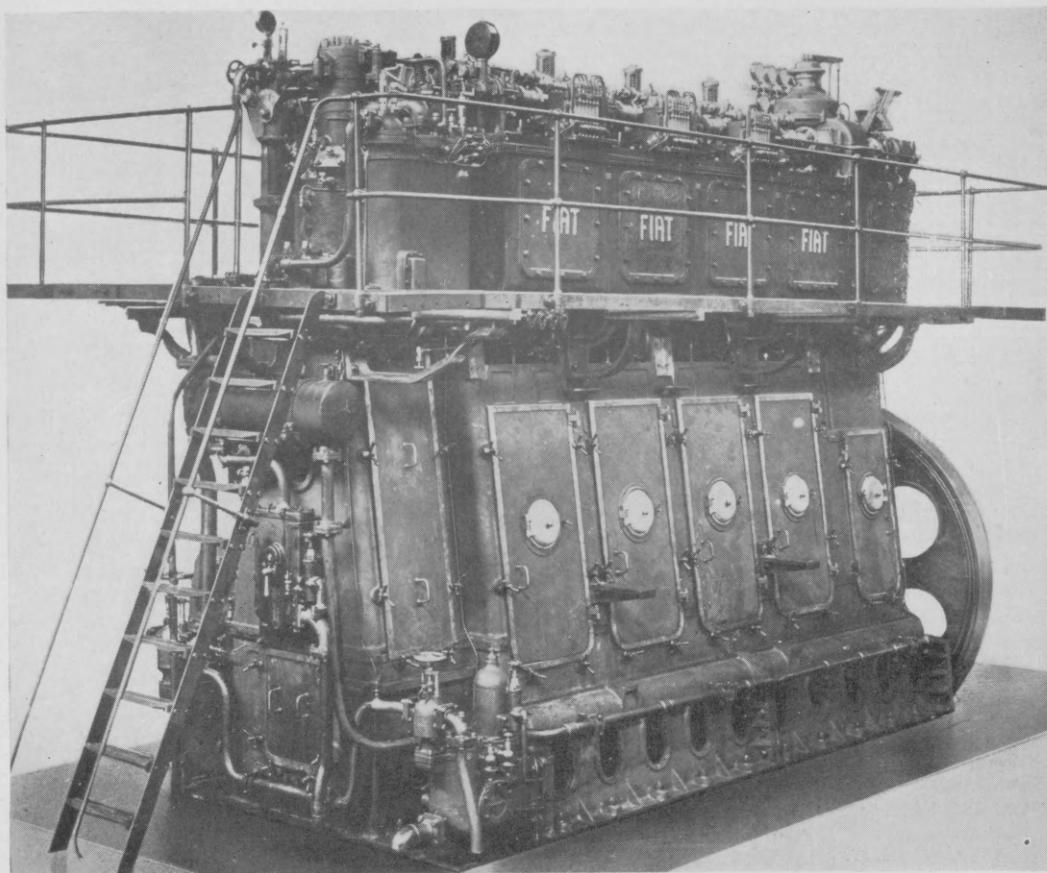


MECHANICAL EFFICIENCY 7 m. 0.796



Cross sections of La Playa's new crosshead Diesel engines





One of the four 950 b.h.p. Fiat Diesels of the La Playa

the overall length is only about 18 ft. 6 in. The height of the engine from crank center to valve tops is 13 ft. 5 in., and the bedplate width is 8 ft. 4 in. Depth from crank center to bottom of bedplate is 3 ft. 8 $\frac{7}{8}$  in.

Each engine consists of four main cylinders, 19.69 in. bore and stroke interposed between a three-stage injection-air compressor at the forward end and the tandem scavenging pumps at the after end.

This arrangement was first used by Fiat on high-speed light-weight locomotive engines built for the Italian and Swedish railways, and was adopted for LA PLAYA for compactness and to improve the balancing of the moving parts with consequent reduction of vibrations.

The bedplate was proportioned so as to fit the existing foundations and the forward end of the generator bedplates; in order to minimize the length, the crank shaft has been forged in one piece with an overhanging portion forward to drive the compressor and the attached lubricating oil and cooling water pumps. The space available immediately forward of the scavenging pump crank was cleverly utilized for the skew gears driving the camshaft. Otherwise, the design resembles the latest and most improved Fiat marine engines of much greater power.

It will be noted that the engines are of the crosshead type and that a division plate, fitted with deep stuffing-boxes, has been arranged beneath the main cylinders, thus effectively preventing the contamination of crankcase oil by any possible dripping of carbon and cylinder oil.

The cast-iron liners are in one piece, held at the top by the studs retaining the cylinder heads, and are free to expand downward. Cast steel has been used for the cylinder heads.

often show the power to vary from 3000 to 5000 hp. between 15 to 20 seconds.

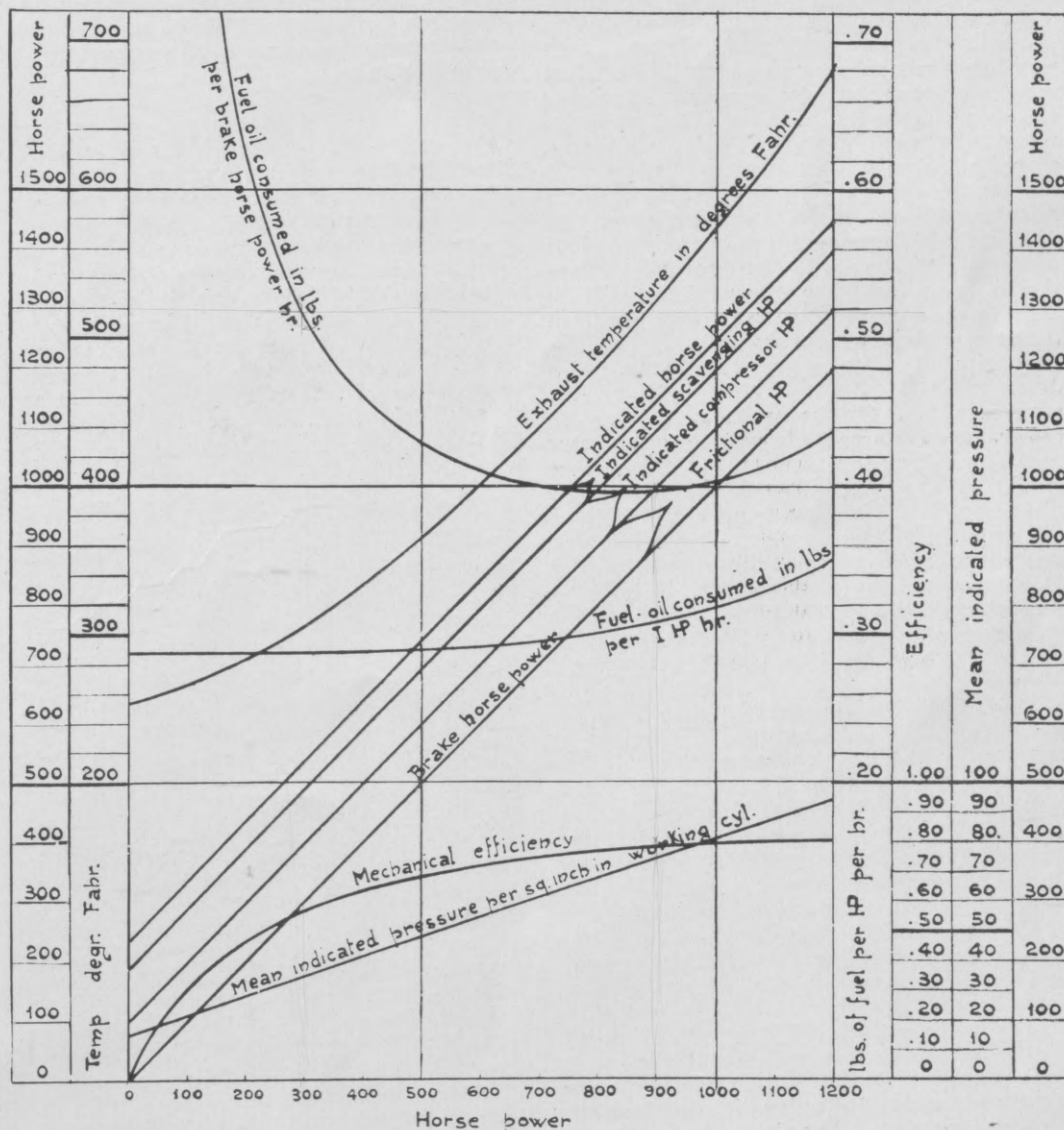
While we are, of course, aware that these overloads can be greatly reduced by suitable electrical arrangements, these devices cannot be of an anticipating nature, as they can only act after the overload has occurred. Therefore, in re-engining the LA PLAYA the owners wisely decided to provide a greater margin of power and accordingly the four new Fiat two-cycle Diesel engines selected were liberally rated at 950 b.h.p. each. The new installation is of particular interest from many angles, particularly as the Nordberg Mfg. Co. of Milwaukee has acquired the right to build this engine under license; also as one of the first American-owned Diesel-electric ships has Fiat engines—the FORDONIAN!

The original Camellaird-Fullagar engines were closely coupled and the rectangular shaped scavenging pumps were arranged above the main cylinders to act as guides for the upper pistons, which naturally leads to an exceedingly compact arrangement even though it has been criticized for lack of accessibility. In the original layout, the fore end of the generator bed-plates were placed eight frame spaces or exactly 20 feet from the forward bulkhead, which not only afforded ample space around the engines, but also permitted placing the daily supply tanks overhead on the forward bulkhead. It became, however, a difficult matter to install engines of an orthodox design and of much larger power in this small space as the shifting of the forward bulkhead, besides proving expensive, would have also seriously reduced the refrigerated space.

Considerable credit is therefore due to the Owners' and the Fiat Company's engineers in meeting this difficult problem with the least expense, and we hope to publish in an early issue the new machinery arrangement together with the results of the impending sea trials and abstracts of the LA PLAYA's first voyage as she is now being outfitted at the Cantiere Navale Monfalcone, near Trieste, where the two large new Cosulich motorliners, SATURNIA and VULCANIA, are also nearing completion.

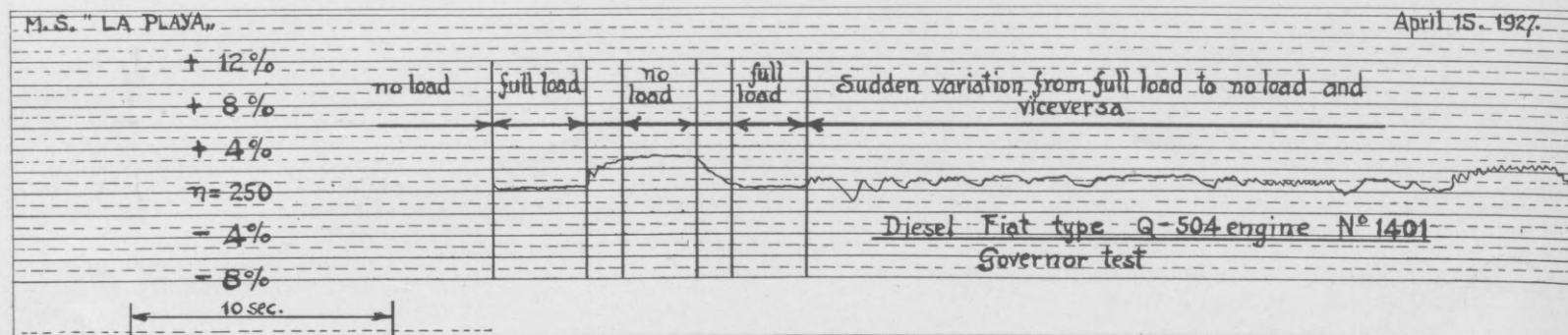
Needless to say, the limitations imposed by

the original installation compelled Fiat to develop a special compact design that would fit in the available space and it will be seen that



Curves of tests of La Playa's engines, plotted on metric horsepower





Governor test curve of La Playa's engine

They are of simple symmetrical conical construction, and project well inside the liners to enhance the cooling of their thickest part.

Salt water is used for cooling the cylinder jackets and large inspection doors are provided at their bottom to permit of inspection and washing-down with a hose. The pistons are also salt-water cooled with the usual arrangement of telescopic pipes. These, however, are designed to effectively prevent salt water from entering the crankcase, as they are packed by outside stuffing-boxes entirely accessible through the liberal sized openings provided in the entablature.

Air is distributed to the scavenging pumps by means of tandem piston valves operated by an eccentric mounted on the crank shaft, the scavenging air being led to a large receiver, cast integral with the main cylinders, which contain the automatic scavenging valves. These valves are plain rings of stainless steel which lift as soon as the air ports are uncovered by the main pistons and the pressure within the cylinder is less than the scavenging-air receiver. Being light and of multiple construction, these rings naturally operate with a small pressure differential.

The engines are non-reversible and each pair of cylinders is arranged for independent starting through a simple system of shafts and levers actuating an air-starting valve arranged on each cylinder head. Therefore, only the fuel valves are cam-operated, one for each cylinder, and being co-axial to each cylinder, this results in a well-balanced and symmetrical arrangement of the heads. This minimum number of cam-operated valves should also make for quietness of operation in a rather crowded engine room, even when all the four engines are running.

Lubrication is by big gear-type pump, which draws the oil from the lower part of the crankcase and discharges to a tubular oil cooler, neatly arranged on the compressor frame directly above this pump. As will be seen from the photograph of the engine, the piston and jacket cooling pumps, together with their air chambers and controlling valves, are also arranged in a neat and compact manner at the forward end of the engine. We are informed that the dry weight of each engine complete is approximately 80 tons or about 180 lb. per b.hp. This is low for a crosshead engine.

The owners having specified that these engines should be built to the requirements of both the British Corporation and Lloyds, the official shop tests of the first engine were carried out on April 15th in the presence of Captain D. H. Young, superintendent engineer, United Fruit Company, F. G. Knott, of Messrs. Esplen & Sons, who inspected the construction of these engines, and representatives of Lloyds and the British Corporation.

Several non-stop trials at fractional powers and overload were run with consumption, as noted in the attached table, from which the results have been plotted in graphic form. It should be noted, however, that these curves were plotted on metric hp., whereas the tabulation has been reduced to English hp., including fuel consumption. The fuel oil used had a

specific gravity of 0.90 at 60 deg. Fahr.

Vacuum oil D.T.E. extra heavy was used for the main and compressor cylinders and during the 12-hr. run at full load the total consumption was 32.2 lb. Throughout the series of trials the exhaust was almost clear, only a slight haze being visible and silencing was efficient.

During the no-load period the governor was severely taxed on many occasions from overload to no-load and vice versa, and sensitive graphs showed that at no time the change of revolutions exceeded 3 per cent in each direction. At the termination of the trials the cylinders were immediately opened up and pistons removed and examined, all rings found free in their grooves and markings satisfactory on both pistons and liners, showing that they had been adequately lubricated. Likewise, the bronze gear wheels for the camshaft drives were examined and their markings were found regular. In general, the trials were highly satisfactory to all concerned as may be evidenced by the remarkable high efficiencies and low fuel consumptions obtained which compare most favorably with engines of much larger power and better ratio of stroke to bore.

Advantage was taken of the re-engining to bring the whole installation up to modern motorship practice. The original daily supply tanks attached to the forward bulkhead were removed to provide space for the new Diesel motors and a new two-compartment tank installed in the engine room casing in the space formerly occupied for the storage of galley coal. An additional gravity tank was also installed higher up to supply two fuel-oil separators which drain directly to the daily tanks located underneath. There previously was installed a De Laval lubricating-oil centrifuge and the two fuel-oil separators were added. Extensive improvements were also effected in the ventilation of the engine room

by the addition of exhaust fans to handle the heated air from the main generators and new supply fans discharging to ventilating mains with branches to the main and auxiliary engine room and the various flats.

With the exception of a thorough cleaning and general overhauling, no changes whatever were made to the main and auxiliary electric equipment, which has performed in a highly satisfactory manner since the vessel has been in operation.

The plans and specifications for this conversion and the general engineering and advisory work were contributed by A. Conti, 11 Broadway, New York, in collaboration with the owner's superintending-engineer, Captain H. H. Young.

## Two Bessemers for U. S. Army Boat

For installation in a new inspection boat to be built for the Engineers Corps of the U. S. War Department's New Orleans branch, two Bessemer direct-reversible airless-injection Diesel engines of 125-150 s.hp. have been ordered from the Bessemer Gas Engine Company of Grove City, Pa. The hull will be constructed by the Charles Ward Engineering Works, Charleston, West Virginia.

## Falk Appoints New Agent

The Falk Corporation of Milwaukee, Wisconsin, manufacturers of herringbone gears, oil engines and flexible couplings, announces the opening of an office in Portland, Oregon, at 720 Terminal Sales Building, 12th and Morrison streets. This office will be in charge of John Jurgensen.

M. S. LA PLAYA  
Official Shop Test—Engine No. 1401—Type "Q-504"  
April 15, 1927

Test	No Load	½ Load	¾ Load	Full Load	Overload
Duration, hr. ....	1	2	2	12	4
R.p.m. ....	257.5	257	253	252	272.5
Load on brake, lb. ....	—	1069	1598	2138	2204
B.hp. ....	—	483	728	965	1075
Fuel lb., per b.hp.-hr. ....	—	.448	.414	.405	.442
Average m.i.p., lb./sq. in. ....	18.37	51.45	61.3	79.15	81.53
Total i.h.p. ....	281	800	940	1210	1346
Mechanical efficiency ....	—	.604	.774	.796	.80
Injection air, lb./sq. in. ....	568	782	853	1066	1066
Lub. oil and cooler inlet, lb./sq. in. ....	38	39	38	40	40
Lub. oil and cooler outlet, lb./sq. in. ....	29	31	31	31	31
Cooling water to jacket, lb./sq. in. ....	17	16	15	17	17
Cooling water to pistons, lb./sq. in. ....	11	12	11	13	14
Scavenging air, lb./sq. in. ....	2.47	2.22	2.32	2.38	2.75
Cooling water inlet, deg. Fahr. ...	58	58	58	58	58
Returns from jackets, deg. Fahr. ....	85	72.5	79.5	84	86
Returns from pistons, deg. Fahr. ....	93	76	82	89	92
Lub. oil before cooler, deg. Fahr. ....	102	95	101	101	112
Lub. oil after cooler, deg. Fahr. ...	80	77	80	84	88
Aver. ex. tem. at cyls., deg. Fahr. ....	266	343	449	557	627

Exhaust clear throughout.

Compressor aid suction ¼ open throughout.

Fuel oil—90 specific gravity at 50 deg. Fahr.



# Two New Navigation Instruments

Electrically Driven Intergrading Path and Position Finder  
Designed to Overcome Yawing of Ships—A Magnetic  
Master Compass

**F**OLLOWING extensive developments two new ship navigation instruments have just been placed on the market. One is a path and position indicator and the other is a magnetic master compass. These



New gyro compass described on this page

two instruments have been developed by Edward L. Holmes, of the Holmes Navigating Apparatus Co., and are outlined in this article.

One of the most serious sources of error in navigation is the cumulative effect of yawing—as the ship's head falls away before the wind or the surge of a wave, and the consequent inability of the man at the wheel to be sure that he has brought the ship's head back on the set course after each of these disturbing movements. The compass alone will not tell him when he has brought the ship back on the set course because the compass is only a directional guide—that is, it does not indicate whether a ship is north or south, east or west, of a prescribed course when she is running parallel with that course.

It was to overcome this handicap, under which both the navigator and the helmsman labor, that Mr. Holmes devised and perfected his path and position indicator. The apparatus gives the navigator a means of determining the course followed by his craft and of establishing her position at any time in relation to the set course. The instrument registers the distance made good as well as the amount of departure from the set course, if such has occurred. In effect, it is an electrically-driven integrating machine that gives readings upon an assumed rate of one knot an hour; and these readings become applicable to a particular vessel by multiplying those readings by the known speed of the ship as deter-

mined by either her log or her revolution counter.

For his "magnetic master-compass" Mr. Holmes has developed a compass in which the card, with its magnets, floats in a special electrolyte; and insulated from these magnets, but carried by the same card, are sections of two opposed circuits through which flows a weak alternating current. This current completes its circuit, in each circuit, by flowing across two submerged gaps between two electrodes on each side of the compass card and two nearby electrodes on the neighboring wall of the bowl. Any relative change in position of all eight electrodes upsets the electrical balance of the two opposed circuits—because of the increase or decrease of the resistance offered by the electrolyte. Instantly, a very responsive relay acts upon a reversible motor, and the motor—directed by the relay, serves to reestablish the electrical balance between the two circuits. This motor actuates a follow-up ring that is mounted above the compass bowl and which carries a phantom compass card.

As this compass card is turned to right or left so as to bring it in unison with the regular card—as the two circuits are again balanced—the follow-up ring makes a succession of contacts, and these may serve to send electrical impulses to one or more step-by-step motors that, in their turn, rotate the dial or dials of a corresponding number of repeater compasses. Plainly, then, the repeaters are made to register in harmony with the "magnetic master-compass", and the "master" can be placed anywhere that will best suit the navigator and be farthest away from disturbing influences. Should the follow-up system be out of service for any reason, the magnetic standard compass—the heart of the system—will be unaffected and free to serve as the prime navigational aid.



Path and position indicator on a tanker

The compass is designed to actuate a repeater compass card on the "path and position indicator." It is by this repeater card that the course is set from any point of departure. When the course is so set, the hand on a dial immediately below the compass card will point at zero. This hand carries a white star to make its movements more readily observable by the man at the wheel. The shifting of this hand at once warns the helmsman that he is to the right or to the left of the set course—the markings reading to three decimals of a mile. To bring the ship back on the set course—not merely parallel with it—the man at the wheel must steer the vessel so that the star hand is at zero and so that the hand above the compass card is in line with the prescribed compass course. As can be seen, this instrument does away with all guessing on the part of the helmsman, and gives him a positive guide by which to bring his ship quickly back upon the set course after her head has been swung off the course by yawing or because of careless steering.

Two other dials are on the front of the "path and position indicator;" one of these registers the distance made good in relation to the set course, and the other registers the amount of departure, at any time, from that course. As has already been explained, it is only necessary to multiply these figures by the known speed of the craft to get the two sides of a triangle. With these two sides thus ascertained, it is an easy matter to fix the ship's position so far as that position is the result of steering and the drive of her engines.

## The Rudolph Diesel Memorial Prize

W. F. Joachim, Mechanical Engineer, Langley Memorial Aeronautical Laboratory has been selected to receive the Rudolph Diesel Award for 1927, consisting of a suitable certificate and a cash prize of \$100 for his paper entitled "Oil Spray Investigations of the National Advisory Committee for Aeronautics," which was presented at the Oil Power Week meeting, April 21-23, 1927, at Pennsylvania State College, State College, Pa.

The Committee of Award consisted of F. Thilenius, Division Sup't., Prairie Pipe Line Co., F. G. Hechler, Professor of Engineering Research, Pennsylvania State College, and R. Miller, Ass't. Chief Engineer, Oil Engine Dep't., Ingersoll-Rand Co.

The Rudolph Diesel Award, established in honor of the man whose name is so closely connected with the modern oil-engine, is given annually in connection with the activities of Oil Power Week, for the best written contribution towards the advancement of oil engines delivered at any of the meetings held throughout the country. This year 106 meetings were held.



# Maneuverability Determines Dividends

"Galvanized Action on Tap" Is Requirement for Man at Controls Whose Responsibilities Will Be Decreased by Graphic Recording

**M**ANEUVERING of ships, whether at sea or in port calls for power—power under control at the finger tips of the engineer available on the instant at the beck and call of the ship's navigator high above him on the bridge. Between these two there has to be some agency of communication, not simply to transmit orders which send a ship's engines rolling from full ahead to full astern in the mere batting of an eye, but also to acknowledge their receipt by signaling back the exact nature of the order received and being executed.

This need for infallibly instant communication between bridge and engine room has increased with the always growing size of ships and as the speed of maneuverability has kept pace with machinery development. From the time honored "jingle bell" to the familiar mechanical telegraph or "Chadburn" and finally to the enterprising electrical telegraph one predominating characteristic had to be proven before its adoption became an accepted fact—that of reliability.

Since eventually, at some time or other when least expected, but almost invariably at a critical instant when most needed, the best device is liable to develop trouble, a second or independent system of signaling, usually in the form of a steam whistle, is provided to insure uninterrupted communication. An ever increasing number of ships is also being provided with telephone connection between bridge and engine room as a further supplementary precaution,—to maintain maneuverability.

What does the term maneuverability cover? Surely not alone the ability of a ship to maintain any chosen course at will. Not simply the ability to slacken speed in a fog or dangerous waters or to heave-to

in heavy seas, nor to avoid collision by prompt backing of her engines. Not merely in the power to crowd on speed to make port at high tide. Maneuverability embraces all of these, yes, but in addition something far more important, namely, instant response of the engineer and his machinery following the ringing down of a "bell." And not merely once, but always, at all times, under all possible conditions—"galvanized action on tap" as one practical marine executive so tersely puts it.

Why is such importance attached to this need for instant response of engines to maneuvering demands from the bridge? How else can the man on the bridge develop that sense of judgment—often called skill—but which is based primarily upon self-confidence and in the knowledge that engine response will follow instantly and correctly, both as regards uniformity of speeds and direction of rotation? Too often the bridge is blamed for swamping the engine room with a deluge of bells, and by none more than the ship's engineers—when they themselves are more than often the primary cause of it, due to their haphazard handling of the engines. A typical example might be more forcible.

Consider the case of a ship maneuvering to swing her stern with little open water for'd of her bow—as, when docking without a tug. The bridge, let us say, rings down for "full ahead" and throws his rudder hard over; if the engine response is instantaneously full speed, the next "bell" will more than likely be stop, to effect the particular maneuver with but two bells. On the other hand however, if the engine is started slowly, picking up speed leisurely, the ship will gather way before the stern has swung as desired, necessitating an astern bell to slack way and back her bow

away from the end of the slip. This would then be followed up by another full ahead to swing the stern over either completely, or else as far as careless engine handling will permit, to then slack way and repeat.

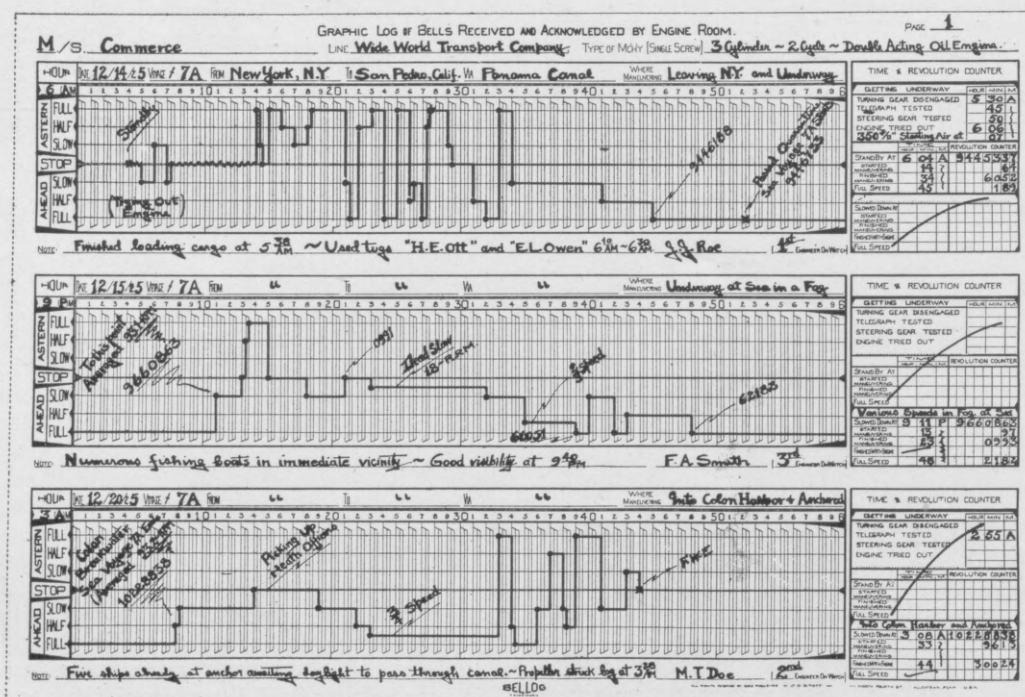
"Excess Bells"—aside from the wear and tear upon the machinery and the cost of such additional maneuvering, together with their tendency to create disastrous confusion—involve money-equivalent delays. Each might possibly not be of any great duration, yet, taken in the aggregate they run into expense, as for example, when a crew of stevedores is waiting on the dock for the ship to tie up, and, moreover, is drawing pay while waiting.

What justification can there be in burning additional fuel, and often, overloading the machinery merely to average an extra turn or two for the sake of clipping something off the running time—and then waste many times this saving by unskillful maneuvering? Time from dock to dock—and not merely steaming time—is what determines a ship's overall efficiency and earning capacity.

Today probably no other single factor which enters into modern ship operation receives more attention and stress than quick turn around. "Unload her for the next cargo"—"Better terminal facilities"—"More efficient cargo handling"—these are the slogans of today. But nothing seems to be said when a ship loses more time than attainment of the above would save, merely through undeveloped maneuverability. For maneuverability like most any other organizational output can be developed. To realize the truth of this, one need only compare operating performance of a ship with two ideas in mind. First, relative results of dock-to-dock time with different men on the bridge under similar weather conditions, and secondly relative dock-to-dock results under one command and engineering regime before and after smooth operation has been attained.

Aside from bettered schedule time, aside from reduction in expenditures for tug assistance, there enters the all important factor—of safety. What a multitude of sins that word covers in ship operation, justifiable in most cases, but more than often merely an alibi to mask lack of skill on the part of the personnel as a whole. Any ship organized for quick efficient maneuvering operates with a much higher degree of safety than the same ship which lacks such ability. Thus maneuvering operations cannot only be carried out in less time, but actually with more safety—just as skill, power and good brakes determine the automobile's handling in traffic. Maneuverability by also enhancing safety serves as preventive protection against such non-insurable losses as are associated with accident, delays, reputation for maintenance of schedules, etc.

What are the factors involved? Mainly those pertaining to any organized effort where achievement of results depends not



Suggested log form which has been used with considerable success

solely on skill but equally upon team work—practiced team work too. Not merely between the bridge and engine room as units, but, of as great importance, among the personnel comprising these respective departments. Each group must be organized for smooth operation within itself—and each individual must not simply know the right thing to do at the right time in his own line of duties but he must have knowledge of the duties of watchmates as well, for accidents will happen. Systematic routine, organization, standard operating practice—these are the mainstays that secure “galvanized action on tap.”

Modern business has found that, regardless of working pressure upon its personnel, one factor is indispensable to its very existence and accordingly occupies first place among routine work. That factor is the keeping of orderly, systematic, condensed but detailed records of its problems and of the facts determining its methods of procedure. Regardless of how apparently valueless the data may be it is recorded and filed—for that is the only way it can be made available when most needed.

What up-to-date business would—or could—operate without such vital factors as its accounting system, its time clocks, its timekeepers and tallymen? What modern organization would disregard itemizing of its expenditures—to consider only in terms of its gross or net return?

Water-borne transportation today employs the most highly developed mechanism yet conceived by man—the modern ship. But are not some phases of ship operation

left entirely too much to personal whim, to chance, to the vagaries of the human element? Has not too much stress been placed on so-called “time honored rule o’thumb” practices as contrasted with modern practice ashore in like cases.

Would not systematic, easily analyzed, shore going records of maneuverability be a simple but effective means of improving one of the most uncertain factors which go to determine a vessel’s earning power—her schedule time from dock to dock?

Would not the resulting enhanced co-operation between engine room and bridge, in itself—aside from the inevitable gains to the ship-owner—warrant the keeping of such shore records?

Would not reliable maneuvering records of the various phases of a ship’s operating conditions be extremely valuable when designing a new ship for the same service—to insure adequate maneuverability without excessive and ineffectual expenditure of money and cargo capacity. For example, what will be the optimum relation between storage and compressing facilities for a particular new motorship’s supply of starting air? What percentage of time does a motorship operate at full power, reduced speed, standing-by. Recorded data eliminates guesswork and costly errors.

Consider the possibility of collision, grounding or other mishaps connected with handling of a ship, in which award of damages is very likely to depend upon the ability of one or the other ships to defend itself against charges of criminal negligence. In such a case, would not the court

give considerable weight to the value of maneuvering records as evidence to prove your contention?

Present records of engine handling operations, consisting of jotting down “conventional” signs and times are faithfully and laboriously kept on most ships for self-protection. Not being easily analyzed, and the signs not always meaning the same, they are looked upon with disfavor ashore, except when needed—at which time this data is not available, or if so, not in as complete detail as may be necessary.

Graphic records however appear to be a solution, for would not a simple, standardized blank chart, having as much of the necessary data already printed upon it as possible, but arranged so that a simple entry would properly and completely correlate the data, find welcome reception by the ship’s personnel as a time saver in recording routine procedure by ship operating officials ashore—as a simple means of placing sister ships on a competitive operating basis through comparison of maneuvering performance?

Such a record, requiring slight but actual attention of someone connected with maneuvering operations, not only promotes safety by compelling him to check himself against confusing signals, but, capable of being backed up by affidavit, would be legal evidence, thus affording all the advantages of automatic recording, but without its limitations, not to mention cost.

J. G. GROFF,  
Former Second Asst. Engineer,  
MS. EAST INDIA.

## Willamette Building Sumner Oil Engine

### Active Production Started on Open Frame Type Crosshead Engine Originally Developed During Early Days of the War

Ten years ago H. W. Sumner designed a crosshead oil engine, the principles of which received such endorsement by Pacific Coast engineers that the first pair of engines were sold to Swayne and Hoyt, of San Francisco before they were built. They were installed in the motor schooner SANTINO. These were the first Sumner marine oil engines. In the next four years, 24 of these engines, a total of 10,800 s.h.p. were sold and installed in ships that sailed the seven seas. This established the Sumner engine, the manufacture and sale of which has just been taken over by the Willamette Iron and Steel Works, of Portland, Oregon, for both marine and stationary purposes.

The Sumner-Willamette Diesel engine is unique from several standpoints. It is an entirely domestic product, having no European or foreign origin. It was not evolved from any domestic gas or steam engine, but was entirely designed by one engineer working alone—not the product of an organization whose work had been previously concentrated on similar lines.

When Henry W. Sumner designed his Diesel engine, the primary idea in his mind was to produce a power plant with which the average marine steam engineer would be able to familiarize himself in the shortest possible space of time. He remembered

that years of steam practice had evolved many things in connection with marine work which were just as applicable to a marine oil engine as to a triple expansion steam engine. Thus, in appearance, the Sumner-Willamette Diesel will be seen to be much like a marine steam engine.

The Sumner-Willamette is a two-cycle, crosshead, vertical, open column marine engine, planned to comprehend cylinder combinations from 4 to 8. It is designed to work on Diesel fuel-oil ranging in gravity from 23° to 28° Baume.

The open column construction—one of the engine’s most striking features—is a great advantage from the point of accessibility. It draws the air into a receiver, which is formed by the crosshead or back column and avoids the necessity of enclosing the working parts. Next to the accessibility of all bearings, the Sumner feature that is outstanding is the combustion system. Scavenger pumps provide an excess of air for scavenging the cylinders of burnt gases, permitting a full cylinder of pure air for the combustion. Ignition is, of course, by compression, and the engine starts cold without the aid of any igniting apparatus. Lubrication is forced to the cylinders and bearings.

On the Sumner-Willamette, all auxiliaries, the scavenging pumps, the air com-

pressors, the water circulators, and the bilge pumps are beam driven instead of eccentric driven. Extreme simplicity and open construction cause upkeep and maintenance charges to be astonishingly low. The vital parts, such as crank shaft, main bearings, crossheads, rods, etc., are all open and in plain view of the operating engineer.

### Rialto’s Maiden Voyage

The 10,000 tons d.w. motorship RIALTO of the Liberia Line recently arrived at San Francisco on her maiden voyage from Genoa, Italy. She is one of five fast cargo motorships, especially built for trade between the Mediterranean and the Pacific Coast of America.

### Coastwise Ships and Diesel Power

From time to time MOTORSHIP has pointed out that the solution of economical coastwise shipping rests with the development and adoption of the medium speed Diesel engine. In this connection it is very interesting to note that three 8400 tons gross motorships now building at Valencia, Spain, for the Compania Transmediterranea, will be twin-screw ships with Diesel engines turning at 225 r.p.m. Each engine is of the six-cylinder, 4-cycle type and develops 800 b.h.p. They are being constructed by Krupp’s at Kiel. The use of medium speed oil engines for short voyage ships means that the first cost can be reduced by constructing a vessel considerably smaller than would be the case if steam power were adopted, but with the motorship having the same capacity as the larger steamer.



## Herman Falk, ex Tuxpanoil, Runs Trials

### Tanker of 10,200 Tons with Falk Twin Geared Oil Engines Driving a Single Screw

Just forty-eight hours after her first dock trials, the converted tanker HERMAN FALK, ex TUXPANOIL, sailed for her loading port in Texas at 4 P. M. on Saturday, the 20th of August. This ship, formerly a Shipping Board tanker was bought by the Oil Transport Company of Baltimore, who contracted with the Bethlehem Shipbuilding Corporation to convert her to Falk geared oil-engine drive.

The HERMAN FALK is a sister vessel to the tanker DISTRICT OF COLUMBIA, which is being equipped with Diesel-electric drive, to the order of the Standard Oil Company of California. When the latter vessel is placed in service, the performances of the two ships will make a very interesting study.

The HERMAN FALK is of 10,200 tons dwc., 450 ft. long, 59 ft. breadth, 25 ft. 4½ in. draft, on a displacement of 14,760

tons. We presume that the tonnage measurements have been somewhat changed by the conversion, and the present figures will be given when the installation is fully described in our October issue. The original power consisted of Parsons reduction-gearred turbines of 2800 s.h.p. at 90 r.p.m. and three Scotch boilers, giving a speed of 10 knots.

The two 6-cylinder Falk geared oil-engines were designed to develop 2600 s.h.p. together, but on trial they actually developed 2850 s.h.p., driving the vessel at an average of 11.1 knots as a mean of four runs over the measured mile on her loaded draft. At this speed, the fuel consumption was only at the rate of 87 barrels per 24 hour day, as compared with their former consumption of 205 barrels per day, so it is not surprising that the owners have advised us that they are very much pleased.

## The Streamline Rudder Principle

### The Oertz System Installed on Many European Ships Now Introduced to America

Unquestionably the rudder of a ship offers considerable opportunity for improvement in design with a view to increasing efficiency, reducing the operating power required, and lessening the resistance. In our issue of June 1926 we gave details of the Tutin balanced re-action rudder and in January 1926 we described the Flettner balanced rudder. Headway has recently been made in Europe with the Oertz ship rudder designed on the streamline principle. This has just been introduced in the United States when a number of shipowners inspected a freighter in New York harbor under the auspices of Wm. Braat, president of the American company.

The principle on which the construction is based has been derived entirely from experiences in aviation, viz. that a comparatively thick wing profile gives the best proportion between lifting power and resistance in longitudinal direction. It is claimed that when applied to the rudder of a ship this means the greatest possible steering effect with the smallest possible resistance. In order to retain this favorable wing profile, also at extreme angles of helm, Dr. Oertz, has designed the rudder in two parts, of which the parabolically rounded forepart is constructed as a fixed guide body around the existing rudder post, or in new building completely replacing the old rudder post; whereas the afterpart of the rudder, the actual turning part, joins the fixed forepart in a complete streamline form.

The turning axis of the movable back part lies at about 1/3 of the total length;

consequently, a distribution of pressure is obtained, resulting in a favorable turning moment; in fact, this rudder construction is said to require only 50% to 70% of the steering power needed for a normal plate rudder of the same dimensions. Through this construction in two parts, not only the ideal streamline profile is retained at every angle of helm but also, as the fixed parabolically rounded forepart always takes up the propeller stream in the center line of the ship, the propeller stream is so completely levelled that behind the ship is seen a very quiet wake. Another of the many features claimed for this two-part rudder construction is the fact that the ship is retained continually steady in its course almost without yawing.

The rudder can be applied to single-screw as well as to multiple-screw vessels, as has been illustrated recently when the North German Lloyd decided to have their 96,000 D.W. ton liner BREMEN, which is to be propelled by four screws, equipped with an Oertz Rudder. The conversion of ordinary plate rudder into Oertz can be made very easily and at comparatively low cost on any existing single-screw ship and on several existing multiple-screw ships as it does not involve any radical changes in the structure of the stern frame or rudder stock and arms.

### Fast Meat and Fruit Motorships

Swan, Hunter & Wigham Richardson, Ltd., Newcastle, England, on August 4th ran

trials of the 11,350 tons twin-screw meat- and fruit-carrying motorship, PORT GISBORNE. This vessel is a sister ship of the PORT HUON and PORT HOBART, which they also built for the Commonwealth & Dominion Line. These vessels are noteworthy for being able to complete the voyage from England to Melbourne in 34 days, averaging a speed of 14½ knots. The fuel consumption of main engines and all auxiliaries is only 27 tons a day, against 95 tons of coal or 65 tons of oil if steam driven. In each vessel twin-screw Doxford Diesel engines are installed.

### Tankers for Gulf Refining

Altogether the Gulf Refining Co. of Pittsburgh-New York and its subsidiaries have ordered 11 Diesel-driven and steam-driven tankers from Palmer's Shipbuilding & Iron Co., Hebburn-on-Tyne, England, of which the sixth and seventh were recently launched.

### German Motorships for Russia

The Soviet Russian trade representative in Berlin has ordered two single-screw motorships in Germany for the Black Sea coastwise service. Each vessel will have an 8-cylinder, 1500 hp. Deutz airless-injection Diesel engine. These engines, by the way, will turn at 175 r.p.m. MOTORSHIP has frequently indicated that the medium speed oil-engine running at 175 to 250 r.p.m. is the solution of economical propulsion of American coastwise vessels.

### Curing Cooling Water Troubles

Shoal draft Diesel and gas boats operating on hand waterways occasionally have trouble with their cooling water systems. This trouble is usually of two kinds. The sand suspended in the water causes undue wear on the circulating pump, and also forms deposits in the cylinder water jackets causing hot spots that sometimes result in cracked cylinders or stuck pistons; also, in the case of engines equipped with centrifugal pumps the air caught underneath the hull when helm is hard over causes the pump to become air bound.

It is rather expensive to install the closed type of water system in which the sea water cools the circulating water condenser fashion. A cheaper method is to employ some type of "well" to collect sand and eliminate the air.

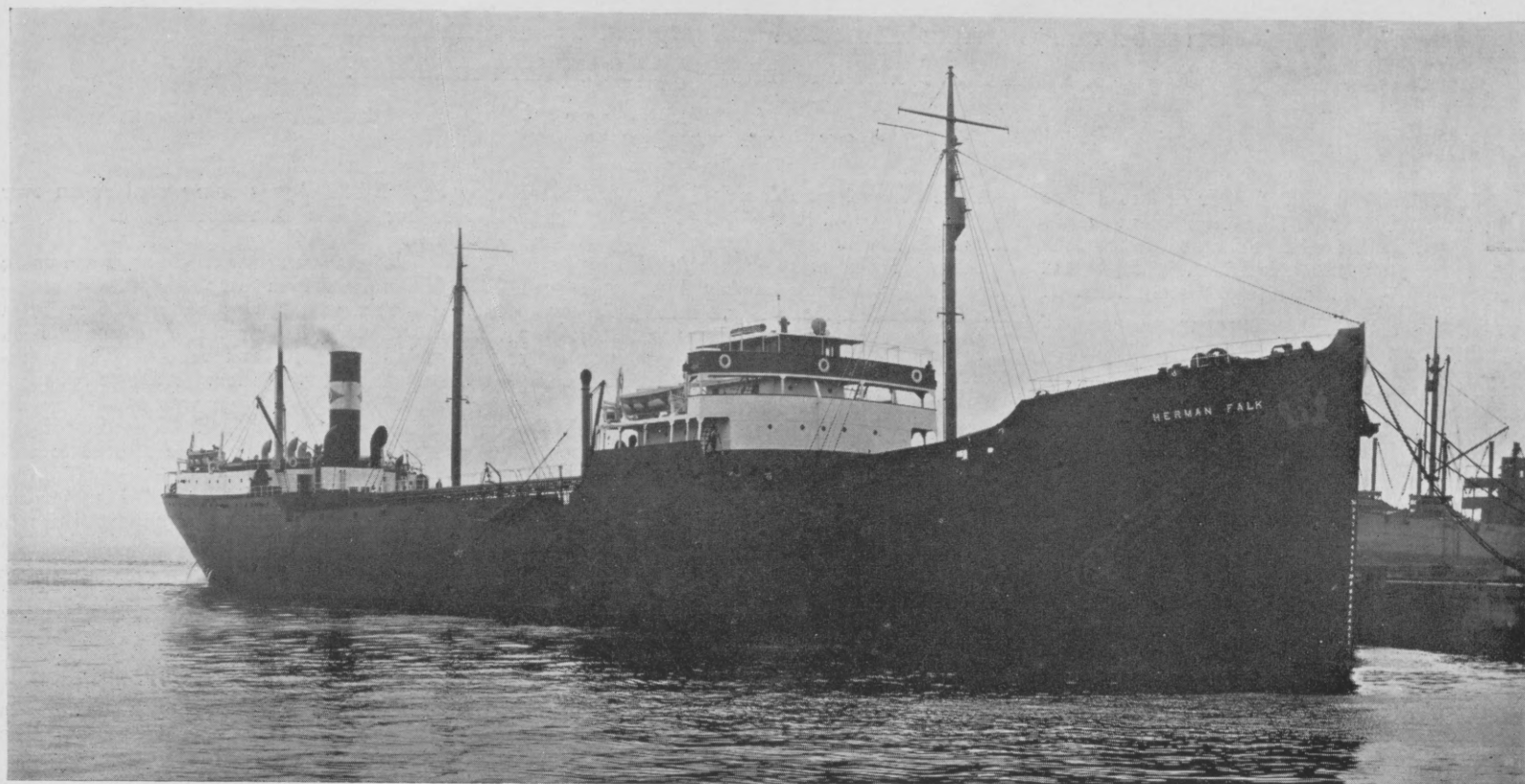
In this case an ordinary 90 gal. water tank was supported horizontally above the ribs at such a height that it was nearly or entirely filled from the sea with the boat "light," and at the same time high enough to provide a gravity pressure to the pump. A 4 in. sea valve and connections were used in order that the water would flow into the tank slowly, giving the sand an opportunity to settle out. The 4 in. sleeve brazed into the top of the tank provides a means of cleaning out the sand by hand when boat is in the water or hosing it out through sea cock when in drydock. The small stand pipe which extends above the high water line carries off all air. The tapped holes in the discharge end of the tank were cross connected with isolating valves to provide a low discharge with boat loaded by the head. When space is limited smaller parts may be used.



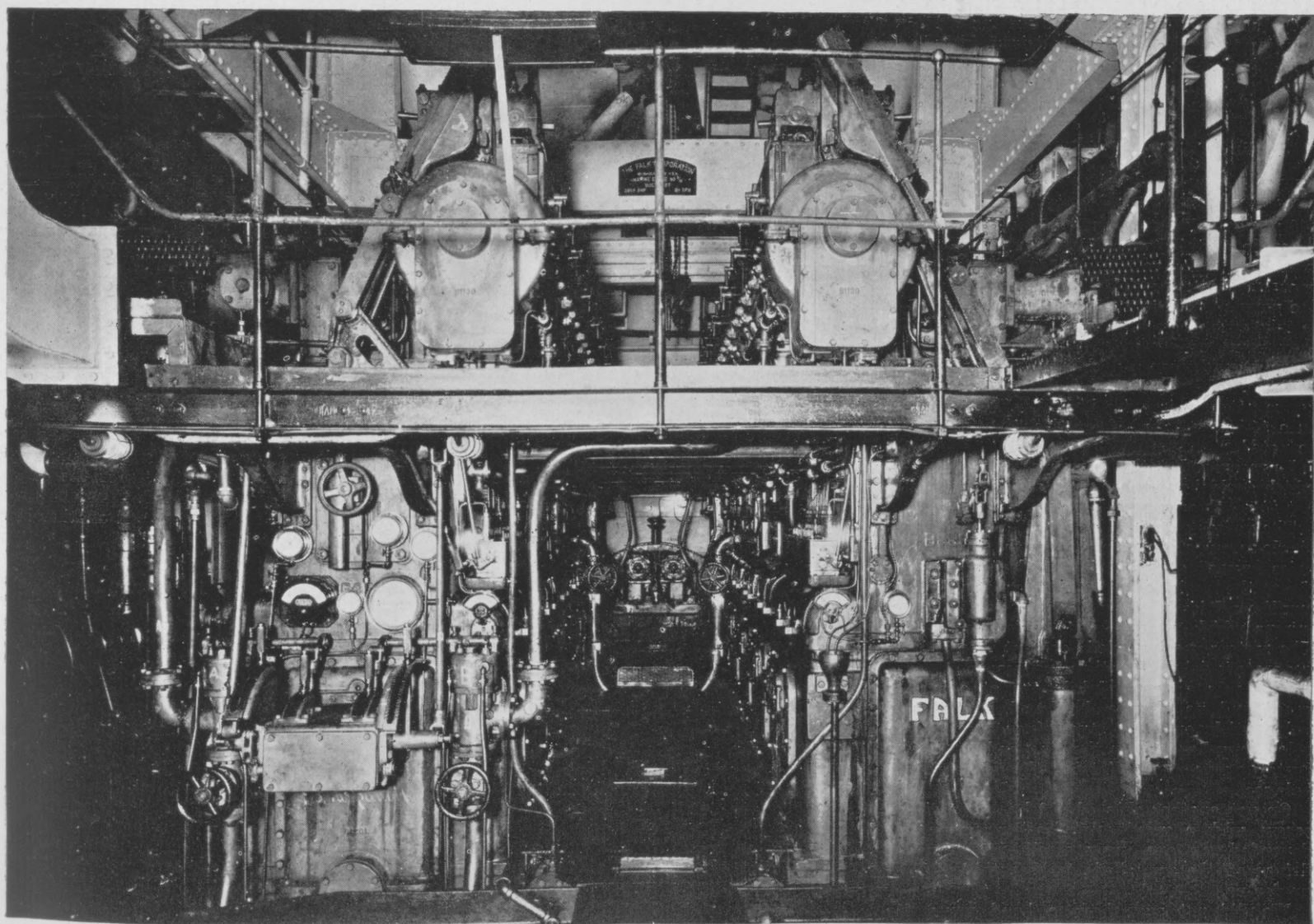
Illustrating principle of Streamline rudder



# America's First Geared Oil Engine Tanker



*The Tanker Herman Falk, ex Tuxpanoil, just converted to Falk geared oil-engine power. She ran trials on August 20. See facing page*



*These twin Falk geared oil-engines together developed 2850 s.h.p. on trials. Part of the reduction gear can be seen in the background. At 92 propeller revolutions the estimated b.h.p. was 3050*





# The Question of Auxiliary Drives

On Motorships Direct-connected and Separately-driven Auxiliary Layouts Each Have Their Merits—Which System Is Better?

By Geo. W. Haggett\*

EVERYONE is to a greater or less degree familiar with the old argument as to which is the more reliable—direct connected or independently-driven pumps and compressors on marine Diesel installations. Of course, all jobs properly hooked up with direct driven auxiliaries, can with advantage, also have enough independent ones to keep going in case of failure of the direct driven units.

While this should be true it is surprising to see how many installations, especially the smaller sets, are depending on one compressor and one set of pumps.

While gathering information on this subject, I have started quite a few discussions among operating engineers and opinions were about equally divided and to a great extent were influenced by the jobs that each man had experienced the least trouble with.

The subject which is often a deciding factor in the mind of the designer of an engine room layout, is first, cost, but in my discussions with operating engineers the difference in cost was not mentioned at all.

An operating engineer, as a rule, does not worry about what a certain piece of apparatus costs, but judges it by the amount of care it takes to keep it clean and in running order.

On some of the latest motorships all the auxiliaries are independently driven, including the main injection air compressors. Recently, however, the writer was present at the trials of a new twin-screw ship of about 4,400 hp., in which all the auxiliaries were driven off the main units—even to lubricating and sanitary pumps.

This was an exceptionally fine installation. In fact, all that was needed to make it a 100 per cent direct-driven job would have been a couple of tailshaft driven generators. The trouble that I observed with this lay-out was that at slow speeds and during maneuvering the pumps would not supply sufficient pressure to take care of some of the systems with which they were connected. Especially the cooling water would stop circulating through about half the systems at speeds below 65 r.p.m. This figure actually is quite high for "slow speed" on a 115 r.p.m. normal speed engine, it should be noted.

I presume that there were auxiliary pumps which could have taken care of this condition, but if so, they were not in use.

The writer was once at sea with a fair sized single-screw motorship in which the auxiliaries were entirely independently driven. Even the main compressor was run by an auxiliary Diesel. This in turn depended on pumps which were driven by electric motors. The motors received their current from Diesel generators driven by other engines.

This was a wonderful layout at a steady speed and no trouble developed. But let a valve stick open or any minor trouble develop anywhere along the line and the whole system was immediately thrown out of balance.

On yet another ship of 400 hp., on a single screw, with a gravity lubricating system, we depended on one very small rotary pump driven off the cam shaft, to keep this oil level up for us.

We did not even have a hand pump for emergency. Needless to say, this little pump

got the best of care for the 22,000 miles we kept it going, and to the best of my knowledge it is going still.

Some of the most successful large twin-screw ships have a standard equipment of direct-driven compressors, each one large enough to supply both engines with injection air properly crossed and with an electrically driven auxiliary compressor with three generator sets and centrifugal pumps. This is a job that is hard to beat and one upon which the engineers will stake their reputations for reliability.

Electrically driven ships with three or more smaller size engines seem to call for independent driven auxiliaries.

A great many of such layouts are being fitted with mechanical injection Diesels. In my opinion, this is a good development, because compressors are a potential source of trouble well done away with except, perhaps, a small set or two electrically driven for starting air. With a pair of electrically driven water pumps and a pair of lubricating oil pumps, the whole job is pretty well taken

care of. Electricity is being used as an ever increasing extent on motorships of all types and sizes.

Many large twin-screw motorships are using independently driven air compressors exclusively. The writer was recently told by a prominent designer that the passengers on one of these vessels had remarked on a certain amount of vibration. As this was described to me, I believe it was caused by the compressor engine. I later learned that the foundations on this ship were altered to correct vibration.

The Shipping Board converted motorship operators will be given good opportunities to check up on direct or auxiliary driven compressors, as some of these ships have direct-driven compressors and some separate driven units. These new jobs are both ways. The question is one which is too large to be disposed of without very mature consideration. Air pumps on steam engines, we must remember, have been driven both ways, ever since James Watts' time, so it is a little difficult to make snap judgments regarding air compressors.

## Diesel Craft for New Orleans

Fuel and Lubricating Oils of 250 s.hp. Mississippi Vessel Only Cost \$8.86 per Working Day

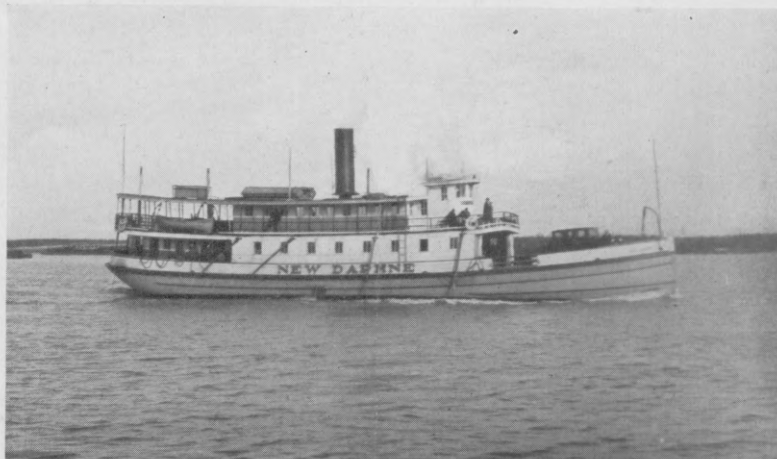
USE of Diesels for marine service on the lower Mississippi in towboats, ferries and packet boats has been developing rapidly during the past few years.

One of these vessels completed recently is the JOSIE, owned and operated by the Daphne Boat Company of Daphne, Alabama, between Mobile and Daphne, Alabama, in automobile and passenger service. JOSIE is equipped with a 180 hp. Fairbanks, Morse Diesel with auxiliary equipment. The boat makes two round trips a day between the above-mentioned points which means that she is operating constantly eight hours per day. The fuel consumption is 82 gallons at 8 cents per gal, or a total fuel cost of \$7.36 per day. The lubricating oil cost averages \$1.50 per day so the total cost of operation is \$8.86 per day.

Ms. NEW DAPHNE, equipped with a 240 hp. Fairbanks, Morse Diesel, operates between

Mobile and Fairhope, Alabama, and makes two trips per day on this run or a total of approximately 8½ hrs. running time. The fuel consumption on this run is 108 gal. of fuel per day or a fuel cost of \$8.64. The approximate lubricating oil consumption is 2 gal. per day, making a total fuel and lubricating oil cost for a day's operation of \$9.6.

Ms. A. T. BEARDSLEE, owned by the Beardslee Launch and Barge Service Company, is equipped with a 45 hp. type "CO" Fairbanks, Morse marine engine, used principally in the running of fishing parties to the Snapper banks which are about forty miles off of Mobile. When this boat is not used in this service, she is used in the tending of ships and towing of barges. The success of the 45 hp. type "CO" engine on the A. T. BEARDSLEE will no doubt cause its owners to add another boat of the same type to their fleet.



*The New Daphne is an efficient boat*

\*Guarantee Engineer, New London Ship & Engine Co.

# News and Notes From Everywhere

## Kitsap County Will Build Ferry

**C**ONTRACT will be let during September for a Diesel-driven ferry by the Kitsap County Transportation Company.

## Bethlehem to Convert the Wilscox

Contract to convert the steamer WILSCOX to Nelseco Diesel power at a cost of \$416,000 has been awarded to the Bethlehem Shipbuilding Corporation.

## Diesel Fireboat Runs Trials

The new fireboat NEW ROCHELLE ran trials in New York harbor on August 25. She is powered with a 360 Fairbanks-Morse oil engine.

## More Furness-Withy Motorliners

Our latest advices are that Furness-Withy are now considering the construction of four 17-knot, 20,000 tons gross Diesel motorliners for the trans-Atlantic trade.

## New Dredges for San Francisco

Decision as to whether Diesel or steam engines will be installed in the new dredges to be built for the San Francisco Harbor Board will be decided by the early part of September.

## The Governors Island Ferry

A Fairbanks-Morse engine of 400 s.h.p. will propel the 128 ft. Governors Island ferry, illustrated in a recent issue, and which is being built by the Spears Engineers Corps., Portsmouth, Va., for the U. S. War Dept.

## Reduction Gear for Motor Tug

An 82 ft. tug just built in Holland is equipped with a 300 b.h.p. Benz Diesel at 450 r.p.m., driving her propeller at 225 r.p.m. through a Burns reduction gear and through a Langdon reverse gear

## Boston to New York Service

In an old 150 ft. trawler hull a 400 b.h.p. Standard Diesel engine has lately been installed by the Merrimac Chemical Company of Boston, who are operating the vessel between that city and New York.

## Rubber Bearings on Dredge

Goodrich "Cutless" rubber bearings are fitted to the overhung impeller of the big suction pump of the Diesel-electric dredge recently completed for the Delaware Dredging Co. of Philadelphia, Pa. Twin 400 hp. De La Vergne Diesel engines drive two 250 kw. Westinghouse generators. There is a 35 hp. Hill auxiliary engine.

## Motorships Replace Steamers

"Every vessel we have laid down in the last two years has been a motorship. The five fast motorships we ordered for our New York-Far Eastern service are giving

splendid service. We are in every way justifying the policy we adopted, after long and careful consideration, of replacing the steamers we previously had employed in that trade"—stated Sir Frederick Lewis at the 36th Annual General Meeting of Furness, Withy & Co. "These steamers," continued Sir Frederick, "we have since disposed of to foreign buyers."

## Double Reverse Clutches for Ferry

A 145 ft. Diesel ferry is being built for Multnomah County, Oregon, for service in Portland harbor. Her dimensions will be 145½ ft. by 44 ft. by 10½ ft. She will be powered by a 250 b.h.p. Atlas-Imperial engine having a reverse clutch at each end, which is expected to give her a speed of 11 knots.

## Another Union Castle Motorliner

A second 20,000 ton motorliner has been ordered from Harland & Wolff by the Union Castle Mail Steamship Company for their South African service. Twin Harland-B. & W. double-acting Diesel engines will be installed.

## Conversion Contract Placed

The Staten Island Shipbuilding Co. will convert the ex Shipping Board tanker CHESTNUT HILL to McIntosh & Seymour Diesel engines under the direction of Angelo Conti, of New York to the order of the Chilian Nitrate Co.

## New Separators for Tankers

A total of six 500 gallon fuel and lubricating oil centrifugal separators have been ordered from the National Acme Co. of Cleveland, for the two big Diesel-driven tankers now under construction at the Sun shipyard, Chester, Pa.

## Motortanker for Great Lakes

The contract to build a 3700 tons d.w. motor tanker for a subsidiary of the Roxana Petroleum Co. has gone to the American Shipbuilding Co.'s Lorain plant. This vessel will be used on the Great Lakes and will be propelled by twin 700 s.h.p. Werkspoor Diesel engines to be built in Holland. The hull will be 344 ft. long, by 51 ft. breadth and 18½ ft. deep.

## Capt. T. F. Day Passes On

Noted for his brilliant marine writings and for twice having crossed the Atlantic in small craft, Captain Thomas Fleming Day, former Editor and Owner of The Rudder, died at his home in New York on August 19th, at the age of 66 years. Born in England, Captain Day came to the United States at the age of six, and from his earliest years in this country was deeply interested in yachting. For a long time, he was opposed to internal combustion engine power, but found out its value when he used it as auxiliary power to his 25-ft. yawl SEABIRD in 1911 when he crossed from

New York to Rome, and later when he crossed the Atlantic in a 35 ft. powerboat in 21 days. Captain Day was one of the finest and squarest men that ever trod a deck and his loss will be greatly felt in yachting circles.

## Beacon Oil Builds in England

To the order of the Beacon Oil Co. of Boston, Mass., a 12 knot, 11,000 tons d.w. tanker constructed on the Isherwood Bracketless system, has just been completed at Palmers Shipbuilding & Iron Co. Hebburn-on-Tyne, England.

## Diesels of 18,000 s.h.p.

Report has reached us that the A.E.G. of Berlin, has completed tests on a large two-cycle, double-acting Diesel engine cylinder, as being the first step of the construction of a pair of 18,000 s.h.p. Diesel engines for a large motorliner to be built in the near future for the Hamburg-America Line.

## Diesel Tug Betty Delivered

Another motortug has been completed for the Goodwin, Gallagher Sand & Transportation Co., Port Washington, L. I. This vessel was recently completed at Fall River, when she made the trip to New York in 16½ hrs. She is 92 ft. long, 21 ft. breadth and 9½ ft. depth and is equipped with a 360 hp. Fairbanks-Morse Diesel engine. This company now owns 9 tugboats, of which 4 are equipped with Fairbanks-Morse engines.

## Diesels Ordered for Long Island Ferry

For installation in the ferryboat, COLUMBIA—now being remodelled at the New York Harbor & Dry Dock Co.'s yard at Staten Island—two Winton Diesel engines of 250 b.h.p. each have just been ordered by the Long Island Sound Ferries, Inc. The COLUMBIA is 150 ft. long by 55 ft. over-all breadth with 6' draft and formerly was a steam vessel operating between Philadelphia and Camden. She is double decked and will carry fifty automobiles and foot passengers.

The work is being carried out under the supervision of Tams and King and is expected to be completed in about three weeks, when the vessel will be placed in service on Long Island Sound between New Rochelle and Sea Cliff on a regular twenty-four hour schedule.

The engines will be direct reversible, and coupled to twin fore and aft shafts. The propellers both push and pull simultaneously. The distance from New Rochelle to Stevenson's dock at Sea Cliff is seven miles. At a later date the steam ferry HUDSON PARK will be added.

Fred A. Wenck, president of the ferry company has planned additional Diesel boats for future service in other parts of Long Island Sound where he is now operating steam ferries.



## New Krupp Diesel Engine in American Yacht

HAPPY DAYS, the big motor yacht recently built in Europe for Col. Ira C. Copley of New York, made the long run to America at an average speed of 12 knots. She has two of the new Krupp airless-injection Diesel engines.

## Sulzer Bros. Busy

Since the beginning of the year, orders have been placed for more than 200,000 b.h.p. in Diesel engines with Sulzer Bros. and their licensees. About one half of these engines are being constructed at Winterthur.

## Two Tugs for Panama Canal

Two new 125 ft. Diesel-electric driven tugs CHAGRES and TRINIDAD were recently launched at Balboa for the Panama Canal Commission. When completed they will have accommodation for 6 American men and 24 colored employees.

## Sulzer Diesels in American Yachts

The new motoryacht CRUSADER owned by A. K. Macomber of New York, is propelled by twin 525 i.h.p. Sulzer Diesel engines. As already recorded Vincent Astor's new yacht will have twin 2100 i.h.p. Sulzer Diesels. The CRUSADER was built at Camper & Nicholson's yard, Gosport, England.

## Diesel Versus Steam

Lloyds' latest figures revealed that for new motorships of over 100 tons gross now building aside from conversions, Diesel power totals 1,102,424 i.h.p. compared with 580,600 i.h.p. in reciprocating steam engines. The motorship has surely arrived regardless of executive barnacles still hampering the progress of several American shipowning companies.

## More Motorships Than Steamers

Lloyds latest edition of its register shows that there are now in service 2552 vessels of 100 tons gross and over equipped with heavy-oil engines, aggregating 4,270,824 gross tons compared with 1374 steamers of 9,228,983 gross tons. This, of course, does not include the vessels now under construction in which the tonnage of motorships exceeds the tonnage of steamers. Nor do the figures include conversions.

## \$494,320 Offered for Wm. Penn

A good indication of the value of motorships over steamers is given by the refusal of the Shipping Board to accept the offer of the American-Hawaiian Steamship Co. to buy the WILLIAM PENN for \$494,320. It will be recalled that the WILLIAM PENN is a freighter of 12,375 tons d.w., and was the last of a series of steamers built by Pusey & Jones for the Shipping Board, only the steam machinery was never installed. Instead two Burmeister & Wain Diesel engines aggregating 3450 s.h.p. purchased by former Chairman of the Board Edward Hurley during the war, were installed after they had been in this country over a year.

Offers of slightly under this amount were made some considerable time ago for the WILLIAM PENN by the Barber Steamship Lines, her former operators, and by the Roosevelt Steamship Line, who are now operating the ship. The Shipping Board has refused the American-Hawaiian Steamship Company's recent offer because it is felt that the price is not adequate and that the ship is needed for the requirements of the present Far Eastern service.

## Two More Diesel Yachts from Germany

Irving T. Bush, of New York has ordered a large Diesel yacht from Krupps of Germany, and the craft is being built from designs by Cox and Stevens. It is reported that E. R. Behrends will also have a Cox and Stevens' designed motoryacht built in Germany.

## Werkspoor Passenger-Cargo Motorship

A 357-ft. combination passenger-and-cargo motorship has been ordered by the Koninklijke Paketvaart Maatschappij from the Netherlands Shipbuilding Co., and twin Werkspoor Diesels will be installed, driving the ship at 15 knots.

## Motorship Development Abroad

Two good indications of the strongly entrenched position of the marine Diesel engine with experienced European shipowners is the fact that to date there are under construction or in service 426 ships totaling 4,926,743 tons displacement with Burmeister & Wain Diesel engines and over 300 vessels equipped with Sulzer Diesels aggregating 1,350,000 hp.

## Great Lakes Motorship to Be Built

Designs on a full canal size motorship are now being worked out for a Canadian Shipping Company by the Dominion Flow Meter Company Ltd., of Toronto, Canada. It is expected to instal a Bessemer Diesel engine. E. R. Mellenger, the engineer in charge of the machinery installation, has been a subscriber for MOTORSHIP since its inception, and states that he has obtained a great deal of valuable information therefrom.

## Exhaust-Turbo Charging

During the six hour trial run, a mean speed of 20.2 knots was maintained by the new motorships HANSESTADT DANZIG and PREUSSEN. These vessels are noteworthy in that not only are they of high power and high speed, but their Diesel engines have been equipped with the Buchi system of exhaust-turbo-charging. In each ship are two ten-cylinder, single-acting, four-cycle Vulcan-M.A.N. trunk-piston Diesel engines. Normally these engines have been arranged to maintain 1700 b.h.p. at 240 r.p.m. when installed in commercial vessels. But, with the new system of exhaust turbo-charging the mean effective pressure was increased by 75% and the total increased power output 138%, as the two engines together on each ship developed 8050 b.h.p. at 317 r.p.m. The mean effective pressure on

the test was 118 lbs. per square inch. This is of greatest interest, because the greatest increase in power was obtained with a high-speed engine, and the designer believes that with slow-speed, heavy-duty engines even better results would be obtained. It is estimated that under normal conditions the constant output of Diesel engines of stated cylinder sizes and speed could be given 45 to 50% increased power with the Buchi system.

## New Long Island Railroad Tug

Eads Johnson has been commissioned to design a new Diesel tug, shortly to be built for the Long Island R.R. This will be the second oil-engined tug to be constructed for this railroad.

## Reported Pacific Coast Conversions

An unconfirmed report has reached us that four M.A.N. submarine type Diesel engines have been purchased from abroad by Pacific Coast shipowning company for installation in Shipping Board hulls.

## More Yacht Engines Ordered

Contracts have been placed for two 600 b.h.p. Winton Diesels to be installed in a big yacht to be built at Pusey and Jones from designs by B. T. Dobson of New Bedford. Two 200 b.h.p. Winton Diesels have also just been purchased for a smaller yacht.

## New Big Motorliner

About the middle of next month the new motorliner ORAZIO is due to start on her maiden voyage from Italy to South American ports. This vessel is of 12,000 tons gross and will be equipped with twin 6000 i.h.p. Triestino-B. & W. Diesel engines. She is owned by the Navigazione Generale Italiana.

## New York-Bermuda Motor Liner

Work is being pushed to completion on the new 20,000 tons displacement, quadruple-screw, motorliner BERMUDA now building at Belfast to the order of the Furness-Bermuda Line of New York. It is expected that she will be placed in service in January next. The hull was launched at the end of July, and very shortly the four 3450 s.h.p. Doxford Diesel engines will be installed. The vessel will be under the command of Capt J. W. McKenzie.

## Augustinia Runs Trials

One of the large fleet of bulk-oil carrying motorships building for the Anglo-Saxon Petroleum Co., London, and to have Werkspoor four-cycle Diesel engines, has been completed by Swan, Hunter & Wigham Richardson, Ltd., and ran successful trials on July 28th. The AUGUSTINIA as she is named, is of 3600 tons deadweight. Twin Werkspoor single-acting Diesel engines are installed, and these were built by R. & W. Hawthorn, Leslie & Co., Ltd., Newcastle-on-Tyne. Seventeen of this new big fleet of Royal Dutch-shell tankers are having the Werkspoor four-cycle double-acting Diesel engines of high power.

# Small Mechanical Injection Diesels

## A Brief Discussion of Mechanical Injection Types, of Preliminary Experiments and a Notation of the Conclusions of These Experiments—Part 2

THE high pressure mechanical injection system appeared to have merit in the matter of controlling combustion conditions. The divided chamber system appeared to be more applicable to 2-cycle design in which the auxiliary combustion chamber of limited oxygen content could be successfully incorporated in the cylinder and cylinder head design.

With the knowledge gained through experience on the air injection system and the meagre information at hand on the mechanical injection system, experiments were conducted to develop small units by the Dow Pump & Diesel Engine Company of Alameda, California, who were one of the pioneers in this movement.

The information at hand on the mechanical injection system suggested a cam-actuated fuel valve in which the needle seat was directly over a nozzle which dipped into the combustion chamber. Fuel at high pressure was discharged at pressures from 2,000 to 6,000 lb. per sq. in. from a fuel pump into a resilient accumulator as shown. The accumulator was a simple steel tube which accommodated the surplus volume discharged by the fuel pump. The fuel passed through a strainer prior to entering the fuel valve body, where foreign particles were strained. The nozzle in the combustion chamber had five holes drilled into its surface in such a way that fuel was directed into the combustion chamber in the locality of the concentrated oxygen. The high pressure behind the fuel nozzle was converted into velocity through the nozzle orifices in such a way that the fuel was presented to the oxygen within the combustion chamber in the form of a fog or mist. The quantity of fuel was regulated by the lift of the fuel valve needle and in this way the speed of the engine was controlled.

A 3-cylinder, 150 b.hp., 4-cycle Diesel of the following characteristics was used for the first set of experiments as illustrated:

Bore ..... 12 in.  
Stroke ..... 18 in.  
Speed ..... 250 r.p.m.

The air compressor was driven by a crank-pin attached to the end of the main crankshaft. This compressor was of the 3-stage type and was amply fitted with intercoolers and aftercoolers. The compressor was so arranged that it could be removed from the main engine unit in fifteen minutes' time. This feature proved to be very valuable when comparing the power obtained from an air injection engine with that of a mechanical injection engine. The flywheel end of the crankshaft was attached to a Heenan & Froude dynamometer. A single plunger air injection fuel pump was retained during the preliminary experiments in order to furnish fuel for the cylinders operating under air injection. Until fairly satisfactory conditions were obtained with mechanical injection on one cylinder, the two remaining cylinders were left untouched and operated on the air injection principle. This arrangement was a very selective one. The engine could be started as an air injection unit operating on two cylinders. The third cylinder could be cut in as a mechanical injection unit.

A special 3-plunger fuel pump was constructed and fitted to the engine and was driven from the camshaft through gearing. The pump was so arranged that each plunger

discharged fuel to its respective cylinder. In the early experiments only one plunger was used to furnish fuel for No. 3 cylinder.

It was understood from experience that regulation of the fuel needle lift was essential for the proper control of the engine horsepower. The simplest scheme applicable to the engine and used for regulating the fuel needle lift, was the providing of an adjustable eccentric in the hub of the fuel valve rocker. By altering the position of the hand lever, any adjustment of the needle lift could be obtained very easily up to a maximum opening.

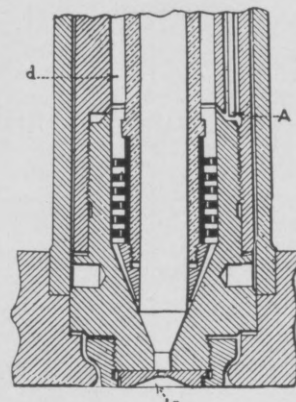
It was understood that some resilience in the system was necessary to accommodate the pulsations of the fuel pump. This resilience had to be of such a nature that it would be safe under the high fuel pressures used and still be resilient enough to accommodate itself to the increased volume discharged from the fuel pump. It was, therefore, decided that better results could be obtained by using long steel seamless-drawn tubing to connect the fuel pump with the fuel valve.

It was obvious that a system of straining must prevent foreign particles from lodging in the nozzle at the fuel valve. This strainer afforded ample straining surface and could be readily cleaned.

The style of air injection fuel valve used on the two cylinders of the experimental engine was of the Augsburg type.

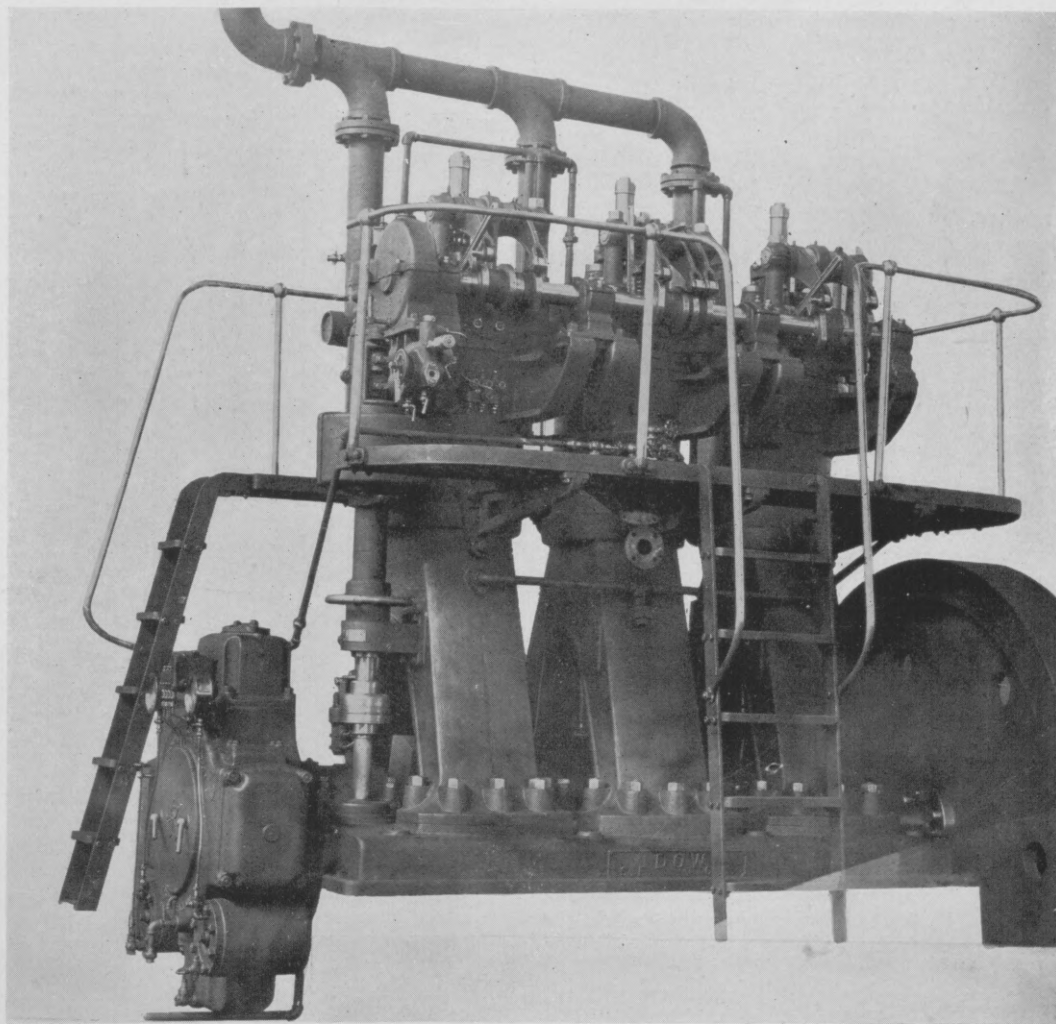
The mechanical injection principle would appear to operate in the reverse order to the

air injection principle. In other words, the fuel would be forced at high velocity into a dense atmosphere of compressed air. The speed of travel of this high velocity of fuel



Augsburg fuel injection valve

would have the same influence in tearing off small fuel particles from the stream as it emerges from the nozzle orifice. In the air injection engine high velocity is obtained by reason of the flow of high pressure air into a lower pressure volume. In the mechanical injection engine it would seem logical to obtain high velocity by forcing fuel at high pressure through small nozzle openings into a lower pressure volume of air.



The 150-hp. 3-cylinder 4-cycle Diesel upon which experiments were carried out



The velocity of the entrance of fuel into the combustion chamber thus appears to be the essential factor in obtaining atomization. A nozzle design was determined by the use of the formula:

$$V = \sqrt{\frac{2gH}{a}} \\ Q = aV$$

where:

V=Velocity in ft. per sec.

g=32.2.

H=Head in ft. equivalent to pressure.

Q=Quantity in cu. ft. per sec.

a=Area in sq. ft.

One cylinder was fitted with the new style of fuel valve and one fuel line connection was made to the mechanical injection 3-plunger fuel pump. This fuel pump was constructed of a solid steel body into which the seats for the suction and discharge valves were fitted. The plungers were hardened and ground and fitted into stuffing boxes provided with soft packing. The fuel pump was of the by-pass type and therefore was fitted for governor and hand control actuation of eccentric shafts and trips which would prevent the suction valve from seating during the first portion of the discharge stroke of the fuel plunger. As each plunger discharged fuel into independent chambers, one fuel pump could be accurately timed to suit the single cylinder fitted up for mechanical injection.

The apparatus just described was designed on the following assumptions:

That a compression pressure of about 450 lb. per square inch as required in air injection practice was necessary for fuel ignition in mechanical injection practice.

That a fuel pressure of 3,500 lb. per square inch was essential for correct atomization.

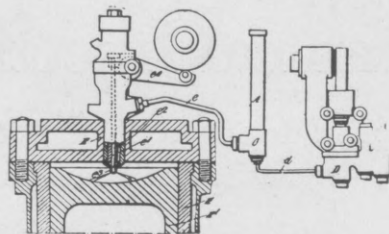
That the combustion chamber found advisable in the air injection engine was suitable for high pressure mechanical injection.

That fuel oil was comparatively incompressible at high pressure and therefore external resilience was necessary to accommodate fuel pump pulsations.

That a single plunger pump properly synchronized with the fuel injection period was ideal.

That the principles of fuel injection were established facts and that mechanical difficulties were the only obstacles to overcome.

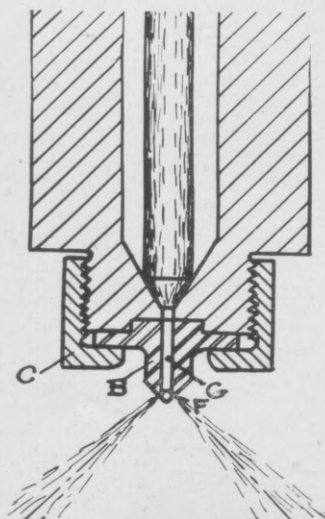
The two air injection cylinders were started and brought up to running speed. As soon as the engine was properly warmed, the third cylinder was cut into operation as a mechanical injection unit. After a series of trials, in which the timing of the fuel valve was altered and the period of injection of the fuel pump was changed, it was determined that a three-hole nozzle was not satisfactory. The engine exhaust was extremely smoky and pre-ignitions would occur if ignition was too early and practically no power would be obtained when ignition was late. The four-hole nozzle was then substituted for the three-hole nozzle. The four-hole nozzle proved to be less smoky and gave opportunity for experimentation with fuel pump timing and fuel valve timing. There was still a tendency toward pre-ignition. It was difficult to keep the maximum peak pressures below 600 lb. When the valve was so set as to reduce the peak pressure below this point, the exhaust immediately became smoky. The fuel valve spring had been designed so as to maintain a tight seat for the needle valve for pressures as high as 6,000 lb. Difficulty, however, was experienced in maintaining a tight seat. The oil would dribble through the seat and into the nozzle. As the fuel passed out through the orifices the fuel would coke. The coking of this fuel, in time, caused carbon tubes to form on the outside of the orifices. After these carbon tubes were removed they gradually accumulated again and would grow to lengths of 3/4-in. if allowed to do so. As soon



High pressure fuel valve and pump

as the carbon tubes would begin forming, the exhaust would become very smoky and exhaust conditions would be greatly aggravated in a short time. It appeared that a slight adjustment of the fuel needle-adjusting washers would assist the needle in seating properly. It was found necessary to make adjustments continually in order to prevent exhaust conditions becoming more aggravated. By altering the lift of the fuel needle or altering the fuel pump pressure or adjusting the fuel needle position on its seat, temporary relief was obtained. The cooling water temperatures ran 15 per cent to 20 per cent higher on the mechanical injection cylinder than on the air injection cylinder for the same quantity of water passing through. The exhaust of the air injection cylinders was clear while that of the mechanical injection cylinders always carried a slight amount of smoke often under the best conditions. From time to time the load on the dynamometer would drop suddenly. This was particularly apparent when the entire unit was operated by the single mechanical injection cylinder and the air injection cylinders were cut out. Twenty-five per cent of the delivered power would suddenly drop off. Upon investigation it was found that one hole of the fuel nozzle had been choked with a flaky substance. This substance was found to be graphite from the soft packing around the fuel needle.

The pressures indicated on the pressure gage varied considerably during the injection period. It was observed that a pressure of 4,000 lb. would be available when the fuel needle opened and that this pressure would drop to 1,500 lb. at the end of the injection period. Under the best operating conditions smoke could not be entirely eliminated



Design of new nozzle

and about 70 per cent of the full load rating was the best power that could be developed.

It was decided that the fuel valve design was responsible for the major troubles. The fuel needle was too large in diameter and therefore presented too much area to the high fuel pressures during the injection periods. The duration of injection as determined on the fuel valve nosepiece was 47 1/2 deg. of crank angle. It was found during the experiments that the eccentric during the fuel needle lift had to be brought down to the

notches which permitted of short time fuel injection. It was found that the fuel valve needle floated during the injection periods and therefore prolonged the time of fuel injection. It was, therefore, decided to design a new valve. By this design the fuel needle was considerably reduced in diameter. The column of oil about the needle valve was diminished considerably. A deflecting ring was placed under the stuffing box to deflect the passage of graphite into the lower portion of the valve body, thus eliminating the troubles encountered by graphite choking. The fuel needle was so designed as to be guided only on the top and centered in the nozzle at the bottom. In this way the fuel needle accommodated any distortions due to the heavy spring pressure.

The nozzle was found to be of incorrect design and a new nozzle of the type shown was designed. The old nozzle was just a flat plate in which a large capacity of fuel was stored behind the orifices. It was thought this plate would have a diaphragm action under the high pressures of fuel injection. This diaphragm would bulge out during the injection period and return to its normal condition as soon as the fuel needle closed. In returning to its normal condition, the volume of fuel stored behind the nozzle opening was of such quantity that it was forced out through the orifices during the lower expansion and exhaust strokes. In this way coking of the fuel occurred on the outer-surface of the nozzle. In the new design the space behind the orifices was reduced to a minimum and the fuel valve needle seat was placed directly above this space to bring it as close to the orifices as possible. In the new design the packing around the needle valve was made very small. In the previous design the large packing required made it difficult to prevent leakages. By the use of narrower packing it was believed that the life of the needle and the packing would be considerably extended and leakages materially cut down.

It appeared that too much resilience was incorporated in the first system. The great fluctuations on the fuel gage made it appear that there was considerable lag in the system. In the second system the fuel pipe was cut down to 6 ft. 9 in., thus reducing the resilience considerably. The volume of the oil behind the fuel valve was also reduced to afford a shorter channel to the source of fuel pressure.

(To be continued)

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